ELECTRICAL REVIEW

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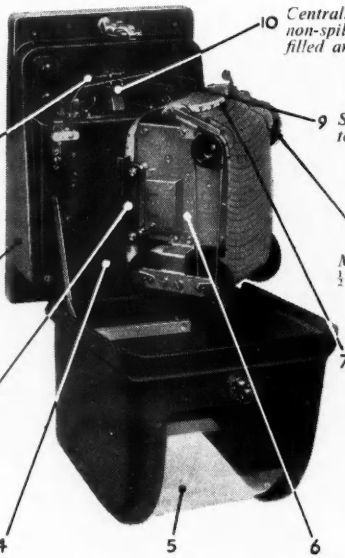

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ELECTRICAL REVIEW

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Lamp Industry Inquiry

QUALIFIED VERDICT UPON E.L.M.A.

THE investigation of an industry by the Monopolies and Restrictive Practices Commission is bound to create an impression that the industry is an anti-social one. Otherwise the exhaustive researches into its history and operations would seem to be unnecessary. There should be a strong prima facie case.

The Commission's examination of the electric lamp industry naturally became a trial of the Electric Lamp Manufacturers' Association. The verdict was not a conclusive one, but at least E.L.M.A. was shown to be not quite so sinister an organization as its opponents have suggested. The Commission's report was reviewed in last week's issue.

Prices Reduced

Broadly, the charges against the Association were that by restrictive practices it had stifled competition and kept up the prices of its members' products. Yet the Association was able to show that its lamps were much cheaper than before the war and lower in price than anywhere except the United States.

So far as the general public is concerned, the inquiry, which entailed the collection of a vast amount of evidence over a period of two-and-a-half years, is not likely to have very great results. After all, the average household requires only about half a dozen lamps a year so that even if any reduction in price follows upon the adoption of the Commission's recommendations the effect on the cost of living will be negligible.

Agreements with Large Users

As regards large users who receive special terms if they undertake to buy E.L.M.A. lamps for the whole or stated portion of their needs, the Commission says that this practice should be brought to an end. It is contended that these agreements are against the public interest. It seems to be rather straining a point to suggest that such purely voluntary arrangements have such a serious effect.

The Commission's proposals appear to aim largely at freeing the retailer from having to make restrictive agreements, although E.L.M.A. is said to have used moderation in its enforcement of these agreements.

Nevertheless it was with principle as well as with practice that the Commission was concerned. It comes to the conclusion that although the system is not wholly evil in its effects it is designed to secure benefits exclusively for the Association's members

and that, by discouraging competition, it injures the public in some way.

So long as certain safeguards are instituted the Commission sees no reason why the E.L.M.A. system should be completely broken up or that members should be prohibited from fixing reasonable minimum prices for certain agreed types of lamp.

The Monopolies Commission was set up by the late Government but as the King's Speech at the opening of the new Parliament foreshadowed the strengthening of the Commission it seems certain that the new Government will take some action. Presumably the Association will anticipate this and voluntarily revise its constitution and methods.

SERIOUS STEEL POSITION

From figures published by the Ministry of Fuel and Power it appears that only 522 MW has been added to the country's installed generating capacity in ten months. It is therefore virtually certain that at the end of the year the net gain will be much less than hoped for and very far short of what is needed. The British Electricity Authority has now made it known that at one station—Connah's Quay—the commissioning dates of new plant are likely to be five months late and, in fact, the lack of structural steel is resulting in the progressive closing down of the site. Clearly the present temporary steel distribution system is not meeting the situation.

WIRING RULES

There have been many proposals over the years for the simplification of presentation of the I.E.E. Regulations for the Electrical Equipment of Buildings. They first appeared sixty-nine years ago as a booklet of a dozen pages. The seventh edition had grown to 50 pages, while the twelfth (current) edition contains some 200, but was changed only very slightly. We accordingly welcome the appearance of the abridged version, briefly referred to on another page, which is applicable only to small dwellings having single-phase a.c. installations. By omitting all matters which are not the concern of men actually working on the building site, it has been possible to simplify the wording and reduce the bulk of the Rules without detracting from their full force. This little " pocket companion " should become a very useful guide to the working electrician.

WELSH WATER POWER

Parties interested in the proposals of the British Electricity Authority to develop further water power resources in North Wales have been notified of the Authority's intention to proceed with three of its eight schemes subject to Parliamentary sanction. This is to be sought in the present session of Parliament. Two of the schemes relate to the existing plants at Dolgarrog and Maentwrog where it is proposed to extend the water-gathering areas; the third is one of the new schemes—that at Festiniog. It is believed that there will be less opposition to these developments than in the case of the other five put forward. If it is permitted to proceed the B.E.A. hopes to have the work completed in 1953 and 1954.

SYDNEY FORECAST

Australia's largest city, Sydney, is served by two electricity undertakings, the Sydney County Council and the Electric Light & Power Supply Corporation, Ltd., while a number of municipalities in the environs distribute supplies obtained in bulk from the County Council and the N.S.W. Railways. As from 1st January next, generation will be transferred to the recently constituted Electricity Commission of New South Wales. It will take over a difficult task, for fuel and plant shortages are if anything more acute than at home. The Sydney general manager, however, considers that the forthcoming year will see a turn of the tide and bring a steady, though slow, return to normal. It would be pleasant to think that conditions in this country warranted similar optimism.

GIFTS FOR E.I.B.A. HOME

More friends of the Electrical Industries Benevolent Association have presented useful pieces of equipment to the E.I.B.A. Home at Broome Park, Betchworth. The latest list comprises workshop tools and appliances of various kinds but there is also a billiards table. These practical gifts are in one way better than monetary donations; the donors have a feeling that they have done something really tangible for the people concerned. That is not to say, of course, that financial contributions are not the best on the whole. The E.I.B.A. Court and committees are better able to judge what is most necessary and they must be given the essential funds to enable them to carry out their plans.

Factory Services and Distribution

New Aluminium Foil Works at Silvertown

By H. RICHARDS, ASSOCIATE I.E.E.*

THE universal demand for increased quantities of aluminium foil products became so urgent in 1947 that Venesta, Ltd., decided to extend the foil rolling section of its Silvertown works. To do this a complete reorganization of that works was necessary. It was decided to move the plywood section to new premises at Erith and to utilize the 145,000 sq ft area vacated for foil rolling.

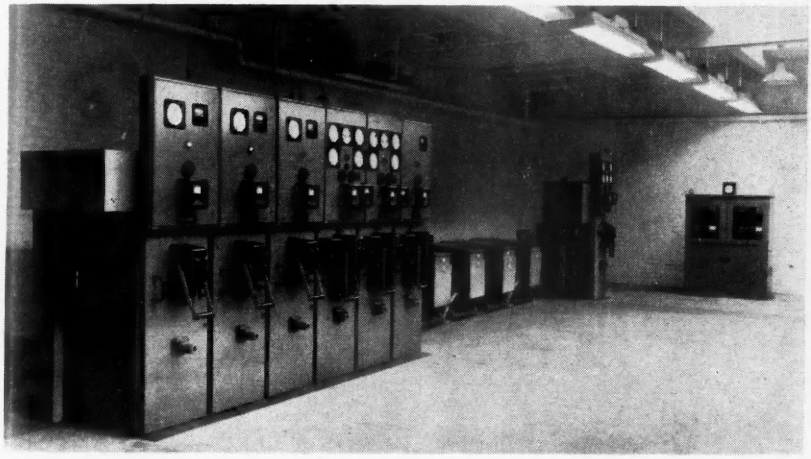
Accordingly, most of the old buildings on the vacated site have been demolished and a new modern structure erected, which in plan forms three-quarters of a square from which the north-east quarter is missing. The centre of the square would have been an ideal site for the substation but the production engineers objected on the ground that the substation floor area, being considerable, would interfere with the natural flow of material, so that an alternative site had to be found. The total connected load is approximately 5,000 kW and as the rolling mill constitutes some 65 per cent of this the substation is sited on the south side of the square overlapping the rolling mill and the processing section. In this position, it is over 500 yd from the main entrance to the factory.

The supply authority has laid two feeders from its 11 kV network to a high voltage switchroom just inside the main entrance to the works. As the factory operates 24 hours a day, to ensure a continuous supply of electricity two 0·2 sq in 11 kV cables have been laid between this h.v. switchroom and the substation. To conform to the supply authority's gear in the h.v. switchroom these feeders are controlled and protected by two Reyrolle 11 kV type C.5T, 150 MVA switch units, which have oil immersed circuit breakers with overcurrent and earth leakage protection.

The substation measures some 150ft by

* F. R. Bullen & Partners.

Part of the main l.v. switchgear in the substation with power factor improvement capacitors and associated automatic control equipment



40ft; it is divided into three sections containing respectively, h.v. switchgear, transformer cubicles, and l.v. switch and distribution gear. The h.v. switchroom contains two ingoing and five outgoing switch units. These units are all Brush type V.A.5. The oil circuit breakers have a carrying capacity of 400 A and a breaking capacity of 150 MVA at 11 kV.

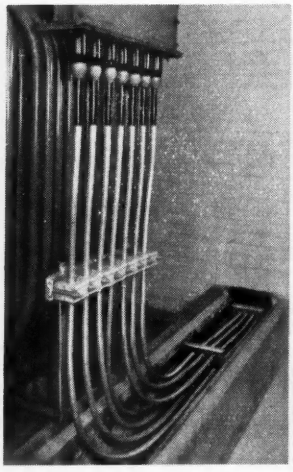
All switches can be automatically tripped by means of an independent d.c. circuit. The two ingoing switches have overload protection only, as the Reyrolle switches at the other ends of the feeders have fully comprehensive protection. The five outgoing switches each control the ingoing supply to a transformer and have overload and earth leakage protection. A feature of the earth leakage protection is that it is paralleled with the earth leakage protection on the main l.v. switch from the relevant transformer, thus ensuring the safety of the transformer under these conditions. All the h.v. switch units are mounted on the solid floor with a covered cable duct at the rear, a single 0·06 sq in, 11 kV, 3-core, p.i.l.c. cable connecting each outgoing switch to its transformer.

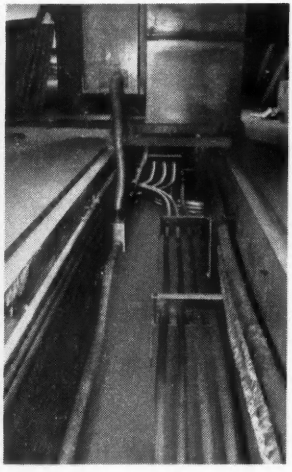
Five Lindley Thompson 750 kVA, three-phase, 50 c/s, 11 kV/433 V transformers are housed in separate cubicles. Each one is mounted on channel iron runners laid across a hollow type pedestal. From each pedestal an oil escape duct connects to a central underground sump for emergency conditions. These ducts have been rendered vermin proof.

Some reference should be made to the reason for this relatively high transformer capacity; an unusually high diversity factor was not the primary reason. Briefly, the choice lay between the provision of one or two large transformers, and five smaller ones. In a works of this description, if the rolling mill section is served by one transformer only and that transformer is shut down the flow of work to the other sections ceases with a resultant total stoppage; or with two transformers the stoppage would be 50 per cent which also would be serious. To obviate this the five smaller transformers were adopted, and three were devoted to the rolling mill section.

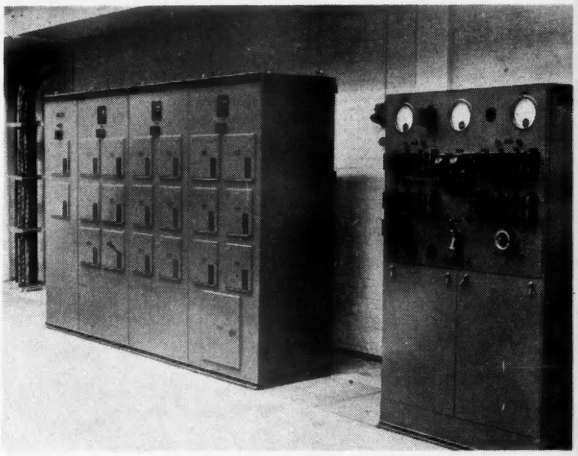
The plant in the rolling mill is grouped in four processes and a third of each group is supplied by one transformer, thus ensuring that in the event of any one transformer being out of commission at least 66 per cent of full production could go ahead. Actually, this percentage can be increased by means of the main l.v. busbar couplers also provided; by these means, great flexibility is provided and minimum breakdown dislocation would occur. Furthermore, the main drive for a number of mills is a 250 h.p. motor and with two such mills or one mill and a 390 kW oven, along with a number of 20 h.p. to 50 h.p. machines, one transformer could be working to maximum demand over long periods although the overall demand for the factory might only be average.

Seven 0·4 sq in single-core cables form the connection between the l.v. side of each transformer and the main l.v. circuit breaker. In the l.v. switchroom five main and nine sub-main circuit breakers, along with six power factor improvement capacitors, are ranged along one side and on the other side are the main distribution units, automatic tripping panel, emergency lighting control panel and batteries.





Left: **Aluminium sheathed cables connecting l.v. side of one of the five transformers in the substation to the main l.v switchboard.** *Right:* **Typical arrangement of aluminium sheathed cables in substation ducting**



One of the four distribution units and emergency lighting control panel in the l.v. switchroom

All the l.v. circuit breakers are Brush cubicle type and outwardly similar to the h.v. breakers. The ingoing breakers are rated at 1,200 A with a breaking capacity of 30 MVA at 440 V and the outgoing breakers are 400 A and 800 A units each with a breaking capacity of 25 MVA. The protection on each l.v. breaker consists of under-voltage, overload and restricted earth fault. The last is set to operate at 20 per cent on the main breakers and 15 per cent on the sub-main.

The units supplied from Nos. 2 and 3 transformers have a busbar section switch as have those supplied from Nos. 4 and 5 transformers to enable both sections to have a restricted supply from one transformer in the event of the other giving trouble or requiring maintenance.

The 250 h.p. motors and large ovens are connected direct to a sub-main circuit breaker, but all apparatus under this size is fed from distribution units having outgoing ways from 60 A to 300 A. There are five of these units which are the Brush "AF" cubicle type with flush fronts, four being in the l.v. switchroom while the other, which feeds the finishing section, is sited locally. All apparatus in the l.v. switchroom is of the streamlined cubicle type finished in battleship grey.

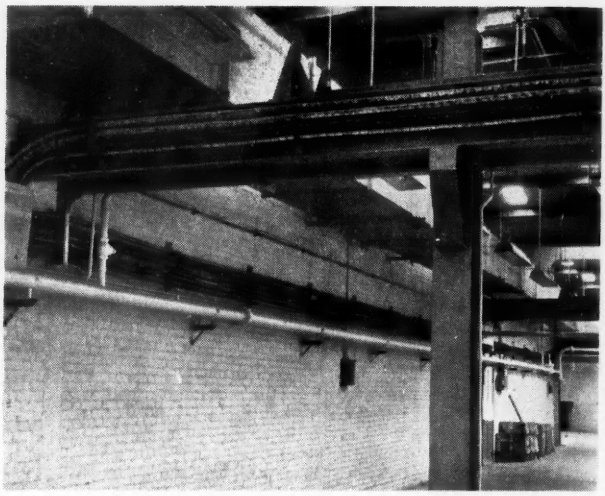
Before leaving the substation, a brief explanation of the power factor improvement apparatus might be interesting. It is fully automatic and operated on the l.v. side by means of two two-stage and two three-stage relays mounted in an enclosed cabinet. Six Johnson & Phillips oil-immersed capacitors are installed, each of 50 kVAr rating with a 150 A contactor incorporated. The installation was designed to obtain a minimum power factor of 0·90 lagging and in actual practice it is maintaining this figure very satisfactorily.

Reference may now be made to the actual cabling method for distributing the various services around the works. For all 400 V services paper-insulated cables are used. For all 230 V circuits v.i.r. cable in conduit with a minimum of $\frac{3}{4}$in size is utilized, while for all services operating below 200 V, such as public address equipment, internal telephones and slave clocks, v.i.r. cable in $\frac{5}{8}$in conduit is used. This in itself has the advantage of warning a maintenance man of the voltage he is dealing with but other advantages soon become apparent.

A typical example concerns the selection of runs of the paper-insulated (400 V) cables. In one section alone, some 50 submain feeders and over 100 final circuit cables had to be erected down the section. The steel joists supporting the overhead crane rails were selected; by using Johnson & Phillips aluminium sheathed cable both the weight of the cabling and the reduction in the number of supports enabled the steel joists to be utilized without modification. The tensile strength of this sheathing made it possible to dispense with all armouring, but there were misgivings about the possibility of a plumber tapping this "tube" for water or gas on isolated runs; accordingly, these cables were jute served over the sheath to give them the accepted appearance of cables. However, all cables with both terminations in the substation were installed without this serving.

Where certain chemicals are utilized in the processing section, precautions have to be taken against fire and fumes. In connection with the latter, the used solvents from all machines are returned to a solvent recovery plant by suction. It was desired

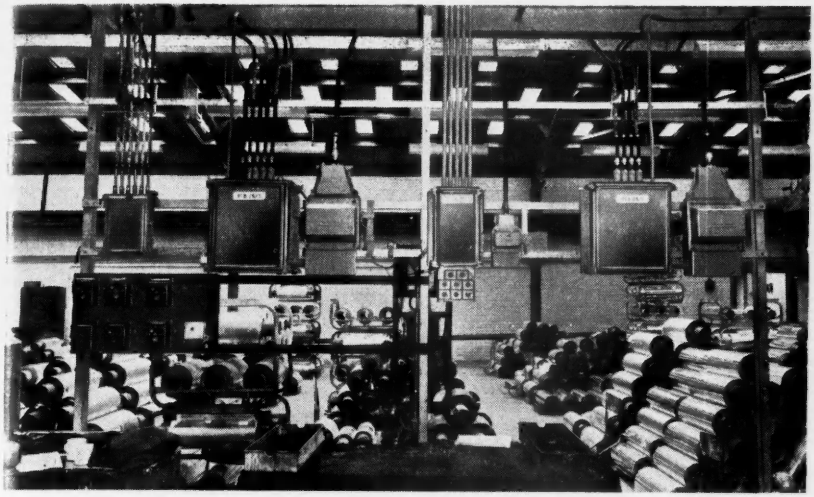
to ensure that the processing machinery should automatically come to a standstill if the suction plant failed. The general way of achieving this is by means of a ring balance operated relay, but in the present case the size of contactor gear necessary to operate numbers of 12·5 h.p. motors on the sub-main feeders was such that the equipment would have been costly. Fortunately, all these motors had automatic starting gear and it was therefore possible for a light-current circuit to be carried to each contactor coil from a double-pole fuseboard. This fuseboard was fed in turn by the operation of the ring balance relay and contactor. Thus, immediately on suction failure, the supply to all the machine hold-on coils is broken.



Owing to their light weight aluminium cables have been run along the crane rails

A brief reference will now be made to the general lighting scheme for which fluorescent tubes were desired. Owing to travelling cranes in every bay the minimum mounting height for the lighting fittings was 17ft and doubts about the suitability of tubular lamps were entertained. After experimenting with 5ft hot cathode and longer lengths of cold cathode tube the hot cathode tubes were adopted. Fittings housing two 5ft 80 W tubes, with instantaneous

Twin 5ft 80 W fluorescent fittings are mounted 17ft above floor level in four longitudinal rows down each bay



All local switch- and fuse-gear is mounted 6ft above floor level

start control gear, were utilized. The fittings were mounted in four longitudinal rows down each bay. With 156 sq ft of floor area per fitting an intensity of 18 lumens/sq ft was obtained. In the processing section with 130 sq ft of floor area per fitting, the result was 30 lumens/sq ft. These intensities will settle down to the planned requirements in due course.

In spite of the provision of modern cloakroom facilities in the factory, articles of clothing could always be found hanging on the switch dollies, and their weight would frequently switch on the lights. To discourage this, the switches were mounted upside down with the dollies pointed to the floor, with effective results.

Of the remaining services, internal telephones, public address equipment and clocks, two features are worth recording. The timekeeping service operates on the slave system, each clock being connected by means of a local two-pin wall socket and plug. A spare plug with the two pins "shorted" is suspended from each socket to insert before a dial is taken down for repair or maintenance. In the case of the public address equipment, a dual 5 W horn or cabinet speaker, mounted 18ft above floor level, gives excellent results at the rate of one dual speaker to 2,800 sq ft of floor, with effective results.

Acknowledgment is due to Venesta, Ltd., for permission to publish this article. The factory extensions and the electrical installation were designed by F. R. Bullen & Partners, consulting engineers, Westminster, S.W.1, under the general supervision of the company's chief engineer, Mr. A. Munro, who was assisted on the electrical side by Mr. G. Whiffen, the installation work being carried out by T. Clarke & Co., Ltd.

E.P.E.A. Bristol Dinner

THERE was no doubt that nationalization of the electricity supply industry, by making possible planned development, the integration of engineering systems and standardization of equipment, had resulted in a significant saving of capital expenditure. This was stated by Mr. S. F. Steward, C.B.E., chairman of the South Western Electricity Board, speaking at the Electrical Power Engineers' Association's dinner at the Royal Hotel, Bristol, on 16th November. Mr. Steward said that the industry's development was hampered by capital restrictions and in the south-west they were faced with the paramount need to improve their ratio of revenue to capital if they were to keep down prices to consumers. Every £1 of capital must be spent to best advantage, and this was largely in the hands of their engineers. The Association played a key part in the structure of negotiation and consultation in the industry, and Mr. Steward paid a tribute to the service rendered to the industry by officers and members.

VIEWS on the NEWS

By REFLECTOR

I DO not suppose that, in general, employees of the B.E.A. and Area Boards are more liable to accident than those in some other walks of life although that is the impression I have gained. A great deal has been said and written lately of their ambulance and first-aid services, largely because of the entry of a number of teams in the second National First Aid Competition. The results are dealt with in a rather elaborate publication (" British Electricity Ambulance Bulletin ") which I have just seen for the first time although this is No. 9. The British Electricity Ambulance Centre entered 116 teams in the National Competition and two of them won trophies. Ambulance work is serious business but judging by the reports in the " Bulletin " there is some humour in the staging of " incidents."

* * *

Among the " assets " acquired on vesting day by the Merseyside and North Wales Electricity Board was a horse-drawn cable-drum conveyor owned by the Hoylake undertaking. Until recently it was in regular use, horses being lent by a local farmer. *Contact* (the Board's magazine) says that although it is known that the vehicle has been in use for over a quarter of a century " some doubt exists as to the authenticity of the records which show its acquisition as being ex-W.D. War Surplus—Carriage Gun, a Mr. Oliver Cromwell being mentioned as vendor."

* * *

A district with the apt name of Over Wyresdale is the subject of a line—cable dispute. The Lancashire County Planning Committee has approved the construction of all but 670 yd of the nine miles of line needed to supply some 24 farmsteads. This short length, however, it considers, should be placed underground because of the special scenic attractions. Both the planning authority and the Lancashire Branch of the C.P.R.E. are said to be anxious for the supply to be provided and a contribution has been offered towards the additional cost of the cable, estimated at £600. The North Western Electricity Board, according to the *Manchester Guardian*, has however declined the offer, pointing out that even if the whole amount were paid it could not spend this sum without exceeding its capital allocation or making a corresponding cut in other schemes. This, it seems to me, unfortunately rules out the possibility of any compromise.

* * *

If electrical contractors are given to blushing those who read a recent article in the *Northern Chronicle* (Inverness) must have reddened a little. It was headed " The Ingenuity of Electricians " and referred to the jubilee of the E.C.A. Let me quote one small passage:—

> " Its members are the back room personnel behind Britain's bright lights—' live wire ' experts who make the sparks fly around the glittering neon signs in London's West End theatre and film land. They are the technicians who switch on the radio-activity in Britain's secret atomic energy stations, instal the lights that blaze out from Britain's airfields, ports and highways."

There is much more in this vein indicating that there is virtually nothing electrical for which the contractor is not responsible. This glowing eulogy of contractors, I find, has also appeared in other newspapers as far apart as Rugby and West London. A Rugby paper credits Aims for Industry, Ltd., for the information.

* * *

The confusion between the initials of the British Electricity Authority and British European Airways is made more confounded by a report in the *Daily Telegraph*. Announcing that the Meteorological Office is supplying long-range country-wide weather forecasts as a possible guide to the use of electricity, it refers to a statement on the subject by a " B.E.A.C. spokesman." This term, I think, would be far better applied to the Airways to conform with the sister organization B.O.A.C.

Bare Electrical Conductors

Simplifying Heating Calculations with the Aid of Graphs

L. H. R. EVERITT, B.SC.ENG.(HONS.), A.M.I.E.E.

THE design of any conductor system is, in most cases, dependent upon the maximum temperature which the conductors may be permitted to attain, bearing in mind that heat may be conducted from them to adjacent apparatus less able to withstand a high temperature. For example, contacting surfaces are required to be maintained free from oxidation and softening, or insulation may deteriorate if its temperature approaches the order of 100 deg C. Mechanical stresses, resulting from expansion and dependent on rise of temperature, also must be maintained within safe limits.

The present object is to present a fairly rapid method of calculating the rise of temperature versus current flow relationship both for continuous and intermittent flows of current. The number of formulæ has been reduced to the minimum and they are simplified by the use of graphs; a complete discussion of their derivation and application to laminated bars is given in a paper by the author (*Journal I.E.E.*, Vol. 92, Part I, No. 58, October, 1945).

To enable a calculation to be proceeded with, the simplifying assumptions are made that the conductor is fairly long in comparison with its width (or diameter) and that, if supported at intervals along its length, such supports are of poor electrical conductivity and therefore of inferior thermal conductivity. The temperature rise in the region of the mid-length of the conductor is then governed solely by the dissipation of heat in a direction normal to its surface, there being no heat flow through its cross-section, the only heat source being the passage of the current through the electrical resistance of the material comprising the conductor. Further assumptions are that the conductors run in a horizontal direction and that, when a conductor is in the form of a flat strip, the main surfaces lie in a vertical plane.

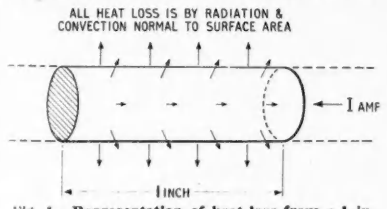


Fig. 1.—Representation of heat loss from a 1-in length of fairly long conductor

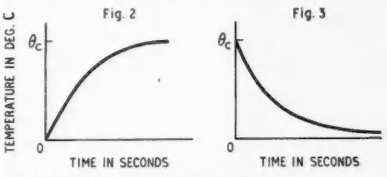


Fig. 2.—Heat rise above ambient temperature from instant of switching on
Fig. 3.—Cooling rate of unit length of conductor

With the possible exception of conductors arranged as a vertical run, these assumptions are justified, in most instances, by good practice and usually permit a small additional safety factor in installations in which the conductor is of short length. In the case of a vertical run exceeding 6ft the temperature rise towards the top of the run is progressively smaller due to the increased speed of the convected air (funnel effect) although as this arrangement is of infrequent occurrence the exact calculation of such an effect is of limited importance and remains as an additional safety factor in such an event.

The problem may then be illustrated (Fig. 1) by a unit length of a conductor that is initially cold at room temperature. The current I amperes commences to flow and heat is generated in the conductor by virtue of its resistance; thus its temperature is raised at a rate expressed in degrees C per second, which is dependent on the mass per unit length (m grammes), the value of the specific heat (s) of the material and the rate of heat loss from the surface. As the temperature of the unit length of the conductor is increasingly raised above

that of the surrounding air and objects (Fig. 2) the loss of heat takes place from the surface at an increasing rate, thus progressively slowing the rate of temperature rise, the heat loss being due to two separate effects, namely, heat loss by electro-magnetic radiation and by convection air currents.

When the temperature rise θ_e (Fig. 2) is attained the temperature will not increase further because the whole of the heat generated within the conductor will be used in maintaining the temperature by compensating for the losses from the surface. If the current flow is stopped the conductor will cool and the rate of cooling be delayed by the stored heat, $ms\theta_e$ calories, in each unit length of the conductor, so that the cooling graph will be of the shape shown in Fig. 3.

It will be appreciated that calculations on the heating of conductors require a knowledge of the following quantities:

Current I amperes and its duration t seconds.

Mass per inch length of the conductor m grms.

Specific heat of the material comprising the conductor, s calories/grm-deg C.

Electrical resistivity of the material comprising the conductor ρ ohm-in.

Surface area per inch length of the conductor, A sq in.

Convection loss expressed in watts per inch length of the conductor, W_C.

Radiation loss expressed in watts per inch length of the conductor, W_R.

W_R is given by the Stefan-Boltzmann law of radiation:

$$W_R = 36{\cdot}9 \times 10^{-12}\, eA$$
$$[(T + 273)^4 - (T_A + 273)^4] \text{ watts}$$

where T = temperature of the hot object, deg C; T_A = temperature of surrounding objects, deg C; while e = emissivity constant = 0·3 for natural copper surface, or 1·0 for an aperture.

W_C is given by a formula which is a simplified form of the original proposed by C. W. Rice in 1923 and has been verified experimentally by the author on conductors ranging in size from $\frac{1}{8}$in to 4in wide; below values of h equal to $\frac{1}{2}$in the constant K has to be progressively increased:

$$W_C = AK\theta^{1{\cdot}25} \div h^{0{\cdot}25} \text{ watts}$$

where K = 0·0022 for cylinders and vertical plane surfaces with major axis horizontal, subject to unrestricted cooling; K = 0·0017 for the facing surfaces between laminated busbars with $\frac{1}{4}$in air space; K = 0·00085 ditto $\frac{1}{8}$in air space; θ = temperature rise above the ambient in deg C; and h = width, or diameter, of the conductor in inches.

To simplify the calculations for non-laminated busbars, the total loss, radiation plus convection, has been calculated for a number of temperature rises and sizes of bar and the wattage/sq in so obtained has been plotted against temperature rise on log-log graph paper. From this graph it has been deduced that over the range now being considered, say 10 up to 40 deg C rise, the total wattage loss/sq in may be expressed by the following equation:

Total loss $w = C.\theta^n$ watts/in^2 ..... (1)

where $C = (W_C + W_R) \div A.\theta^n$ in which case, W_C and W_R must be calculated for the same value of θ, which can be any convenient number between 10 and 40. The value of n varies a few per cent either side of 1·22 depending on the conductor size. For the sizes now being considered (from 0·5 to 4in) the value of n = 1·22 will give results to within one deg C.

The result of solving this equation for various values of h and θ is shown plotted (Fig. 4) for ambient temperatures of 30 to 40 deg C in accordance with the usual British Standard requirements. It is interesting to note that, had the index of θ been unity the curves depicted in Figs. 2 and 3 would have obeyed the well-known natural laws of growth and decay: $y = 1 - \epsilon^{-x}$ and $y = \epsilon^{-x}$ respectively.

For calculation of the continuous rating of a conductor the final steady temperature rise θ_e will be such that the whole of the wattage generated in each one-inch length of the conductor balances the total radiated

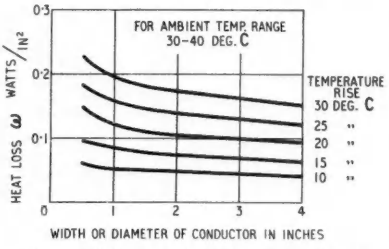


Fig. 4. Relationship of total heat emitted by radiation and convection to the vertical dimension of the conductor

and convected loss from each inch length of the conductor, none of the heat generated being used to increase the temperature of the conductor,

i.e., $$I^2R_{\theta c} = wA$$

in which w may be obtained from Fig. 4, corresponding to the value of h and θ_c relating to the problem in hand; $R_{\theta c}$ is the resistance in ohms per unit length of the conductor at the temperature rise θ_c deg C which, for the maximum allowable resistance for high conductivity hard drawn copper bar, is given by $0{\cdot}658 \times 10^{-6}$ $[1 + 0{\cdot}00427\ (T_A + \theta)]$ divided by the cross-sectional area of the bar. The last expression is shown graphically (Fig. 10) for 30 to 40 deg C ambient temperatures thus, $I^2 = w.A \div R_{\theta c}$, whence I for any given set of conditions.

Example: Find the continuous current rating of a $\frac{5}{8}$in diameter copper busbar for a temperature rise of 30 deg C above a 30 to 40 deg C ambient temperature:

$A = 0{\cdot}625 \times \pi = 1{\cdot}96\text{in}^2$

$c.s.a = (0{\cdot}625)^2 \times \pi/4 = 0{\cdot}307\text{in}^2$

$R_{\theta c}$ from Fig. 10 $= 0{\cdot}840 \times 10^{-6}$

$\div\ 0{\cdot}307 = 2{\cdot}73 \times 10^{-6}$ ohms,

while w from Fig. 4 corresponding to 0·625 and 30 deg C is 0·22 watt.

Therefore $I^2 = 0{\cdot}22 \times 1{\cdot}96$

$\div\ (2{\cdot}73 \times 10^{-6}) = 0{\cdot}158 \times 10^6$

Hence $I = 397$ amps.

For the calculation of intermittent rating

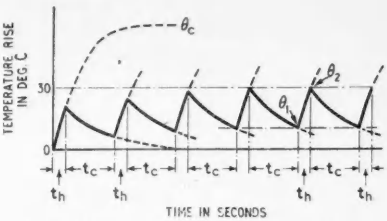


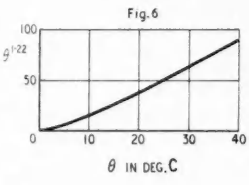
Fig. 5.—Temperature rise over a number of cycles of regular heating-cooling periods

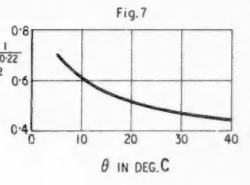
Fig. 5 is a graph of temperature rise plotted as time progresses of a conductor subjected to regular " on," " off " periods t_h and t_c respectively. After the initial transient phase the trough and crest temperature rises, θ_1 and θ_2, repeat themselves as shown at the same values.

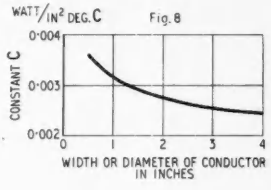
The one simplifying feature adopted is that θ_c, which is the final temperature rise that would occur without a cooling period, is much higher than the crest temperature rise θ_2 and at least twice the range $(\theta_2 - \theta_1)$. Under this condition the heating curve from θ_1 to θ_2 is practically a straight line and in any case its curvature is approximately constant. Obviously for intermittent rating the value of the current will be considerably greater than that for continuous rating, so that these conditions usually exist.

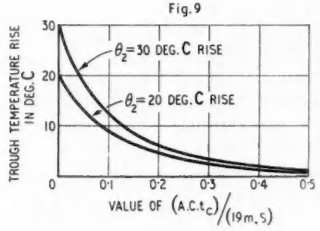
During the heating period, if a small interval of time equal to δt is considered and the amount of heat generated, minus the amount

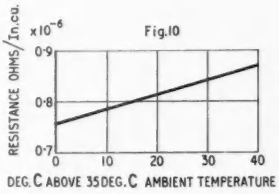
Figs. 6 10.—Graphical aids to determination by calculation of heat rise above ambient temperatures











lost by radiation and convection during this interval, is equated to the amount of heat absorbed by the conductor in the same time, it follows that

$$\delta t \times [I^2R\ (1 + \alpha\theta) - A.C.\theta^{1.22}] = 4{\cdot}18.\ m.s.\ \delta\theta \text{ watt-seconds.}$$

The factor 4·18 is Joule's equivalent, to convert calories to watt-seconds. On the assumption that the curvature from θ_1 to θ_2 is very slight and approximately uniform, then a straight line drawn from θ_1 to θ_2 will have the same inclination as the tangent to the actual curve at a point half-way along it, i.e., at the average temperature rise of value $\theta_a = (\theta_1 + \theta_2) \div 2$.

This straight line will then be expressed by the above formula if we insert the average temperature rise θ_a in place of θ and $(\theta_2 - \theta_1)$ for $\delta\theta$ and t_h for δt and then transpose, thus:

$$I^2R_a = [4{\cdot}18.\ m.s\ (\theta_2 - \theta_1)/t_h] + A.w_a \quad \ldots\ldots\ldots\ldots (2)$$

where R_a = resistance at the average temp. rise, θ_a, and w_a = total watt loss/sq in at the average temp. rise, θ_a.

The value of w_a may be obtained from Fig. 4, corresponding to the value of θ_a while R_a may be obtained with the aid of Fig. 10.

Before equation (2) can be employed to obtain I amperes it is first necessary to calculate θ_1 from the cooling curve having the initial temperature rise θ_2 of specified value.

In cooling, the heat lost by the conductor in a small interval of time δt is equal in value to the decrease in the amount of heat stored within the conductor. This relationship may be expressed as:

$$CA\theta^{1.22}\ \delta t = -\ 4{\cdot}18\ m.s.\delta\theta$$

Integration yields the following expression:

$$\theta_1 = \left[\frac{A.C.t_c}{19{\cdot}0\ m.s.} + \frac{1}{\theta_2^{0.22}}\right]^{4.54} \quad \ldots\ldots\ (3)$$

Values of $\frac{1}{\theta_2^{0.22}}$ and C may be obtained from Figs. 7 and 8 respectively for any particular set of conditions. Alternatively, if the crest temperature rise θ_2 is specified at 30 or 20 deg C the graph (Fig. 9) will solve equation (3) directly if the product $[A.C.t_c/19{\cdot}0\ m.s.]$ is first worked out with the aid of Fig. 8.

Example: Calculate the rating of a 2in by ⅛in copper busbar for a regular heating and cooling sequence of two minutes "on" and 13 minutes "off" (B.S. 587) if the crest temperature is not to exceed 30 deg C rise with a 30 to 40 deg C ambient temperature:

Surface area/in run, A	=	4·25in².
Mass in grms/in run at 145·7 grms/in³, m	=	36·4 grms.
Specific heat of copper, S	=	0·092 cals grm-deg C
Heating time, t_h	=	120 secs.
Cooling time, t_c	=	780 secs.
Crest temperature rise, θ_2	=	30 deg C.

Thus $[A.C.t_c/19{\cdot}0\ m.s.] = 0{\cdot}143$.

As $1/\theta_2^{0.22}$ by logarithms or by reference to Fig. 7 = 0·474, therefore by equation (3) $\theta_1 = 1/(0{\cdot}617)^{4.54} = 1{\cdot}620^{4.54} = 9{\cdot}0$ deg C. Alternatively, if one uses the value of $[A.C.t_c/19{\cdot}0\ m.s.]$ calculated above, the value of θ_1 equal to 9 deg C may be obtained directly from the graph of Fig. 9.

During the heating period the average temperature rise θ_a is $(30 + 9) \div 2 = 19{\cdot}5$ deg C. The resistance per inch length at the average temperature by calculation, or from the graph (Fig. 10) corresponding to 19·5 deg C, is $0{\cdot}81 \times 10^{-6}$ ohms-inches which, dividing by the cross-sectional area, gives $3{\cdot}25 \times 10^{-6}$ ohms/in run. The value of w_a corresponding to 19·5 deg C, from equation (1) or Fig. 4, is 0·102. Inserting these values in equation (2) gives:

$$3{\cdot}25 \times 10^{-6} \times I^2 = [(4{\cdot}18 \times 36{\cdot}4 \times 0{\cdot}092 \times 21) \div 120] + (4{\cdot}25 \times 0{\cdot}102)$$

$$= 2{\cdot}45 + 0{\cdot}43 = 2{\cdot}88$$

whence the current rating I = 940 amps.

Skin Effect of A.C.

The alternating magnetic field, associated with a.c. flowing within the conductor, induces secondary currents in the conductor of the same frequency but of varying phase relationship, depending on their position in the cross-section. The effect is that the resultant current tends to be concentrated nearer the surface, or skin, of the conductor.

The effective resistance is thereby increased by a multiplying factor known as the skin coefficient and is appreciable at 50 c/s for solid conductors larger than about ⅜in diameter and for flat conductors of thickness greater than ¼in for widths above 2in. For instance, the skin coefficient for a single copper conductor 4in by ¼in is approximately 1·12, which thus lowers

the current rating for a.c. to the extent of 6 per cent.

Large conductors running in proximity to each other require an additional resistance multiplying factor because of the effect of the magnetic field of the conductor inducing secondary currents in the adjacent conductors. This factor is known as the proximity coefficient. For complete data on these two factors reference should be made to the "Smithsonian Physical Tables," or to the "Calculation and Design of Electrical Apparatus," third edition, by Dr. W. Wilson.

Supply in Sydney Area

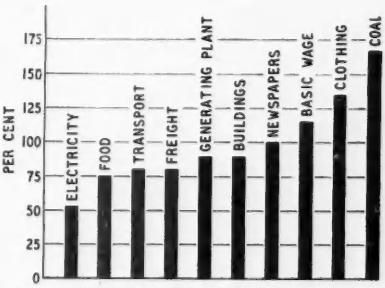
Continued Power Shortage

FROM Australia we have received the 1950 annual report of the Sydney County Council—the first by the present general manager, Mr. C. J. Craggs, who succeeded Mr. G. S. Boyd in that office in August last year. Coming shortly after the publication of the Electricity Board reports at home, it provides useful material for comparison between conditions in the two countries. One of the main British problems, that of drastically curtailing system extensions and reinforcement because of Government restrictions, is absent, but even in Sydney one project, at least, has been limited because of cost and other reasons. Instead of completing the change-over to a.c., the d.c. supply is to be retained indefinitely for lifts and other plant and appliances in view of prevailing conditions.

In the insufficiency of plant to meet the demand Australia shares Britain's difficulties. Last year there was no amelioration of conditions in Sydney. Not only was industry required to reduce its demands by 30 per cent, but systematic load shedding was imposed to a greater extent than in 1949. Inadequate coal supplies constitute a serious problem in New South Wales, which in 1949 experienced a disastrous six weeks' strike. Because of the inferior fuel with which the Sydney authority has had to make do, it has not been possible to operate the coal-fired stations to their full rated output. Some improvement, however, has resulted from the installation of two 165,000 lb/hr Velox oil-fired steam raising units which have the further advantage of being able to produce a full head of steam within five to ten minutes. A small addition to the plant capacity was obtained by feeding into the system the output (2,500 kW) from two naval salvage vessels which were equipped with rotary convertors. Some 8,000 kW was also derived from surplus factory capacity. Any substantial aid must await the commissioning of the Pyrmont "B" power station, where 200,000 kW is in course of installation, and an additional 50,000 kW at Bunnerong "B" (see *Electrical Review*, 9th November, page 969).

It was planned that the next scheme should be the establishment of a new power station at Lugarno, on the Georges River, designed to add 300,000 kW to the Council's generating capacity. This project, states the report, has been deferred by the direction of the Electricity Commission of New South Wales. Constituted by the State Government in May, 1950, the Commission is to take over the generation of electricity from the Sydney County Council, the Department of Railways, the Southern Electricity Supply, and the Electric Light and Power Supply Corporation, Ltd., on an "appointed day" which has been fixed for 1st January, 1952.

The maximum load met by the Sydney



Relative increases in the cost of commodities and services between 1940 and 1950

authority last year was 308,900 kW, which may be compared with potential demands of 470,000 kW rising to 625,000 kW in 1951–55. Thereafter, tentative forecasts indicate loads reaching 900,000 kW by 1960.

Apart from the varying quality of fuel, supplies of which were drawn from no fewer than 43 underground and open-cut mines, the average cost at power station sidings rose from £2 2s 6d to £3 a ton. Labour costs were substantially higher, the basic wage rising from £6 12s to £8 5s. The operation of a three-shift maintenance system at Bunnerong added considerably to costs. The result was that notwithstanding a 12½ per cent increase in charges there was a deficit on the year of £503,346. Sales of electricity advanced by 17 per cent to 1,303 million kWh, but allowing for the shut-down of industry during the miners' strike in 1949, the true increase is in the neighbourhood of 8 per cent. A further 5,698 consumers were connected, making 303,346 in an area of 151 sq miles with a population of 1,058,540. The average price received per kWh sold was 1·574d (against 1·434d). Overall cost of 1·676d/kWh included 0·81d (against 0·71d) for generation.

Clearing Up Misconceptions

Fuel Economy and Peak Load

SPEAKING at the annual dinner of Bristol Branch of the Electrical Contractors' Association, Mr. S. F. Steward, C.B.E. (chairman, South Western Electricity Board) said it was a pity that some of the serious misconceptions about the use and development of electricity were securing such wide publicity.

He recalled that a conference on fuel and power shortage was arranged recently in London by the Combustion Engineering Association. "One could have hoped that in a conference of this kind, with a number of distinguished speakers, that a balanced approach to this problem would have been maintained throughout, but I must confess that quite a number of the speakers appeared to regard the conference as an opportunity to attack the development of electricity without regard to the enormous economy in high-grade coal which has resulted from the use of electricity in its proper sphere. I think it is important for all of us to see that our staff who are in direct touch with the consumers are well informed and able to cultivate a correct understanding of the value and use of electricity."

Mr. Steward gave as an example domestic water heating, and asked if it was reasonable or sensible to suggest at a time when the country was desperately short of coal that Electricity Boards and contractors should not help their customers to enjoy the enormous advantages in fuel saving, cleanliness and cost of summer water heating by electricity.

"There is so much confusion between fuel economy and peak load. Fuel economy must apply to all fuels and, in particular, to the high-grade coal which is not used in our power stations. There is no merit in continuously running solid fuel appliances, even those that are really efficient, when a short off-peak use of electricity will do all that is necessary."

The peak load was electricity's special problem, and he suggested that it was the duty of the Board and contractors to make quite sure that in their keenness to expand electrical services they did not encourage development which militated against the broad national interest. But the peak load and load-shedding question needed to be put into proper perspective. The recent report of the British Electricity Authority showed that the total units lost by load-shedding represented only about 1 per cent of the total units demanded.

Putting the position another way: the national plant deficit at time of winter peak in severe weather might well be 2,000,000 kW. Assuming that in the South Western Board's area the demand would not be more than 1/20th of the national total, the shortage would be of the order of 100,000 kW. The Board had 500,000 domestic consumers and if only one in five of them switched off one bar of an electric fire at the time of peak load, the Board's load-shedding and peak load problem would be solved.

Mr. Steward referred to the co-operation and good relations which existed between the Board and contractors in the South West, because of a thoroughly practical and tolerant attitude on both sides. They were, after all, members of the same industry and partners in the same public service. They had a common interest in seeing that their great industry had a fair deal and was allowed to play its full and proper part in the national economy. Although the industry was passing through a difficult phase the problems were those of success, and if they tackled them sincerely and honestly in partnership there was no cause for discouragement or alarm.

Yorkshire Board Fined £20,000

Six Months' Imprisonment for Chairman

THE case against the Yorkshire Electricity Board, its chairman, Col. W. M. Lapper, and its deputy-chairman, Mr. F. Newey, was concluded on Friday last at the Leeds Assizes before the Lord Chief Justice (Lord Goddard). The Board, which had pleaded guilty to five charges concerning the overspending of an authorized amount for extensions at its headquarters at Scarcroft, near Leeds, was fined £20,000. Col. Lapper was found guilty on two charges and sentenced to six months' imprisonment and Mr. Newey was fined £100 on one charge.

Concluding his evidence, Mr. L. T. Appleyard, architect for the extension, did not agree with a suggestion by Mr. D. Gerrard (for Mr. Newey) that he had under-estimated for the building work. Asked why he had not applied for supplementary authorization for extra work in strengthening the tower so that it would support a heavy water tank, the witness said that this was incidental to the heating scheme with which he was not dealing.

Mr. G. A. Farthing, electrical engineer on the commercial staff of the Board, said that on Mr. Newey's instructions he accepted estimates for various electrical installations costing over £10,000. He was also asked questions about the four clocks in the tower, another clock in the dining room and television sets.

Cross-examined by Mr. Gerrard, Mr. Farthing said that Mr. Newey would not pass anything connected with the heating installation until he had gone into it thoroughly from the financial point of view. With regard to the tower clock, Mr. Newey initially authorized only two faces; the decision to have four faces was taken at a progress meeting and so far as he knew Mr. Newey had nothing to do with it as an individual.

Answering the Lord Chief Justice, the witness said he had never heard anyone discussing whether authorization should be applied for in connection with the heating.

Details of Expenditure

Mr. E. Van Ham, chief accountant to the Board, said that the total spent at Scarcroft was £117,945, which included the cost of the three extensions but not the cost of purchase. The gross total spent on extension number three, the subject of the charges, was £69,551, of which £60,130 was for building work, including new work and repairs, and £9,421 for electrical installation and fittings. Thermal heating cost £14,385. His department was not responsible for applying for authorization.

This concluded the case for the prosecution.

Mr. Geoffrey Veale, K.C. (for Col. Lapper), submitted that neither his client nor Mr. Newey were officers or directors within the meaning of Section 91 of the Defence Regulations, but Lord Goddard rejected this submission. Mr. G. R. Hinchcliffe, K.C., for the prosecution, said that the case would go under Section 91 of the Defence Regulations and not under "aiding and abetting."

Col. Lapper's Evidence

Giving evidence, Col. Lapper said that the normal course of the Board's work required many licences. Any scheme put forward by a chief officer would go to the Board for approval of the expenditure and authorizations from the Ministry would be sought through the normal channels by the chief engineer's department. The Board had nothing whatever to do with making applications. Replying to Lord Goddard, Col. Lapper said that the Board did not take precautions to see that authorization was obtained for these big schemes. A very elaborate scheme for extending the Scarcroft headquarters, inherited from the Yorkshire Electric Power Co., was rejected by the Board as impracticable and more modest schemes in three stages were planned.

Col. Lapper denied that he had told Mr. Appleyard to report directly to him and not through Mr. Siviour, the chief engineer. He did say that he could come direct to Mr. Newey or himself to discuss the plans since Mr. Siviour was so far away. Following a letter from the Ministry of Fuel and Power he told Messrs. Siviour and Appleyard that they must prepare plans to meet the Ministry's requirements. He had not seen the revised plans but he had no hesitation in thinking that they fitted in with the Ministry's requirements.

Later the witness said that it was never suggested to him that any further authorization was required, that work was being done that was not covered by the authorization already obtained, or that it was not in accordance with the plans.

Lord Goddard asked Col. Lapper if he knew that the sum authorized was £32,000. Col. Lapper said that he had read the minutes on the subject but the figure did not register in his mind. He had not inquired about the cost of the building. He was away when the authorization had come through.

Col. Lapper agreed that when a further £18,000 was approved he saw the figures for both authorizations. The total amount approved for expenditure at one progress meeting was half a million pounds.

Questioned by Mr. Gerrard, Col. Lapper said

that Mr. Newey's special concern was the Sub-Areas. He had the job of marrying 50 different concerns into one concern and that into seven divisions.

Answering further questions, the witness said that they did not deal with matters of detail except when someone brought problems to them. They tried to deal only with the four chief executive officers. He had never concerned himself with 56A licensing. He agreed with Lord Goddard that this licensing was an important matter. He had never given any instructions ; the chief engineer sent out a complete memorandum on the subject and he was perfectly satisfied with that. The memorandum did not state who had to make the application.

Col. Lapper said he was away from Scarcroft a great deal. Mr. Appleyard was in charge of the job and he knew the licensing procedure. He did not agree that he had given direct instructions to Mr. Appleyard ; the latter was not under his supervision.

Asked by Lord Goddard who did give Mr. Appleyard instructions, Col. Lapper replied that he would say that it was general policy discussed by the chief engineer, Mr. Appleyard and himself. Mr. Appleyard was just given general instructions ; he had reported directly to him (Col. Lapper) only two or three times.

When Col. Lapper said that he trusted that the chief engineer and the architect were carrying out the work economically, Lord Goddard asked if he was putting all the blame on to Mr. Siviour. Col. Lapper replied that his thoughts were that the architect had badly let Mr. Siviour down. Lord Goddard asked if the chairman had no responsibility. The witness said he was so far removed that he had to rely on other people carrying out their duties. Questioned regarding pencil marks he had made on the plan, Col. Lapper said the alterations he had made were minor ones. He expected Mr. Appleyard to alter plans submitted to and approved by the Ministry without consulting him. He did not realize at the time that the removal of a partition wall and stanchions would result in enlarging the dining room or in extra brickwork. His main desire had been to obtain more office space.

The witness said he had been shocked to find there had been no application for licences for heating and lighting. The matter had fallen between two departments.

Lord Goddard asked if the provision of headquarters for the Board was such a small matter as to justify mere glancing at documents. Col. Lapper said he was sorry to have given that impression ; he kept in touch with the important matters and was always stressing economy.

Mr. Hinchcliffe referred to the departure of the contractors' men a month before the opening date. Col. Lapper said that that was the architect's idea. He (witness) had not seen the contractors' letter pointing out the requirements of the building regulations. He had no knowledge at any time that the authorized amount was being exceeded or that the Ministry's requirements were not being complied with.

Mr. Newey then gave evidence. He said that all licences for headquarters building work were applied for by the chief engineer's department. Mr. Siviour was a man of the highest integrity and he had no hesitation whatever in trusting him implicitly. He would have expected the architect to include provisional costs for electrical installations in his estimate, but not for heating apparatus. He assumed that the £32,000 covered wiring but not electrical fittings.

" Broken Link " in Procedure

In the matter of application for licences, he said there was a " broken link " between the architect and the chief engineer and because of misunderstanding, application for a licence for the heating became nobody's business. He blamed no-one ; the fault was the breakdown of the machine.

Mr. Newey said that he did not know of the alterations in the plans for the dining room until the inquiries. He was opposed to the panel heating system until he was told that the slight extra cost would be covered by contingency items. When, at a progress meeting, the Board authorized the expending of £17,000 he thought that application for any additional licences would be made forthwith.

Mr. Newey said he had done his best to stop an answer suggested as a reply to a question in the House of Commons. When he recovered from the shock of seeing the information in a memorandum which showed overspending he called together such officers as were available, including Mr. Packer who had drawn up the memorandum. " We were told that the answer, suggested by London and agreed at this end, should be that the work had now been completed and that the Board had expended the amount authorized." Mr. Packer had told him that the answer had been suggested by a Ministry official. He did his best to stop that answer being given.

For Mr. Newey, Mr. Gerrard submitted that in the schedule of unauthorized expenditure which had been produced there were nine items of which Mr. Newey could not possibly have known anything. The department handling applications for building authorization was that of the chief engineer, Mr. Siviour. Through a misunderstanding of a conversation, at which Mr. Newey was not present, between the chairman, Mr. Siviour and Mr. Appleyard, a link was broken in the procedure for making applications for authorization.

All Mr. Newey knew was that up to the time of building this extension the procedure for making applications had worked properly. Nobody had suggested that it was his responsibility to look after 56A authorization.

Lord Chief Justice's Summing Up

In his summing up Lord Goddard said that the case was of great public importance. It had disclosed matters which the jury might think showed a lack of organization and a failure to appreciate the necessity of strict compliance with the law. Col. Lapper and Mr. Newey were full-time salaried members of the Board and it was their duty to see that the law was carried out as well as to see that the Board functioned properly.

In this case the whole question was whether the defence had proved that the offence was committed without their knowledge; they were not concerned with the matter of negligence. It might be that the jury would feel that it looked as though here was a nationalized concern, run on public money, able to go to the Ministry for authorization and get it and then go ahead without taking the trouble to find out whether the authorization was being exceeded or not.

He (Lord Goddard) was surprised to hear how Col. Lapper in the witness box spoke about his duties and how far he was removed from this matter and how he belonged to so many national and international bodies. If he was appointed chairman of the Board then that was his duty and if he found that his time was taken up he should not give his time to international organizations but to the duties for which he was paid.

No-one would suggest that in an organization of this size every detail should have to go before the Board, but it was certainly the duty of the chairman and deputy-chairman to see that the law was carried out.

Both the chief engineer, Mr. Siviour, and the architect, Mr. Appleyard, had said that Mr. Appleyard was to report directly to the chairman and that was not challenged in cross-examination. The prosecution said that if this was correct then Col. Lapper must have had a direct interest in the extension.

It was rather unfortunate that everybody, with the honourable exception of Mr. Newey, had tried to put the blame on somebody else for what had happened. Everybody had tried to say that it was Mr. Siviour's fault and that he should have obtained authorization. Did the jury think it was fair to put all the blame on Mr. Siviour? They might think that Mr. Newey was much fairer on this point than Col. Lapper; Newey did not attempt to disguise the fact that there had been a regrettable breakdown and whoever was responsible that responsibility would go right through.

He could not help thinking that the curiously casual way in which the Ministry had dealt with the matter from the outset had largely led to the whole of this trouble. Where was the control if the Ministry gave blind approval of a plan without knowing the least bit about it—a plan which did not say whether the building was to be in marble, brick or stone? The whole of the lamentable story was due to the fact that no one from the Ministry downwards to the young architect, got out a specification for the work.

It had not been suggested that Col. Lapper had derived any personal advantage or that any alterations to the extension had been for his aggrandisement. The alterations made to the plan in Col. Lapper's handwriting showed that he must have known about it, even if he did not know that it was an offence.

Referring to the Parliamentary question which led the Ministry to write to Col. Lapper indicating that an offence had been committed, Lord Goddard said that the Ministry received a reply which seemed to lack frankness and had resulted in a misleading reply being given by a Minister. The explanation Col. Lapper gave to the Ministry was not the one he gave in the witness box.

It was certain that Mr. Newey knew afterwards of the alterations to the dining room but no one had suggested that he gave any instructions or that he knew that alterations were being made on Col. Lapper's instructions.

A formal verdict of not guilty was returned on two charges against Col. Lapper and Mr. Newey relating to unlawful work on some tractor sheds and at Bramhope, near Leeds, and Lord Goddard discharged the jury from giving a verdict on the first count—unlawfully carrying out work at Scarcroft.

After an absence of two hours the jury found Col. Lapper guilty on two charges: of overspending by £41,217 an authority to build an extension, and carrying out work not in accordance with plans submitted to the Ministry. Mr. Newey was found not guilty on the overspending charge but guilty on the charge of non-compliance with the plans.

The Lord Chief Justice said that as the jury had found Col. Lapper guilty he had the painful duty of acting on their verdict and he sentenced him to six months' imprisonment. Addressing Mr. Newey, he said that he had been convicted of a much smaller offence. The maximum fine he could impose was £500. It was unfortunate that Mr. Newey had not spoken out when he found what was being done but he mitigated the fine in his case to £100.

Mr. H. B. H. Hylton-Foster, K.C., on behalf of the Board, said that the people who would, in fact, bear the punishment of the Board would be the consumers. Lord Goddard said that he was aware of that but he had to impose a fine which indicated the gravity of the offence. He fined the Board £20,000 and ordered it to pay the costs of the proceedings.

The Board Meets

A special meeting of the Yorkshire Electricity Board was held at Scarcroft Lodge on Monday to consider the position that had arisen. Mr. Newey, deputy chairman, presided. Mr. H. R. Preston, the Board's solicitor, and Mr. J. M.

Dodds, secretary, attended the meeting. The Board members present were Ald. R. Barber, Ald. W. Leach, Mr. H. F. Sherborne, Mr. R. E. Crowe, Councillor H. Fairbotham and Ald. J. H. Bingham. The only absentee was Mr. A. R. Baines, who is in America.

After the meeting, Mr. Newey called a meeting of the 130 members of the staff. He told them that no decision had yet been taken with regard to the future position of members of the Board. It was the wish of the Board and the staff that the interests of the consumers should be maintained, and he was confident that they would do everything possible to show their loyalty to the Board. It was understood, Mr. Newey said, that at a very early date the Minister would make a statement which would indicate his wishes. In the meantime he appealed to the staff to show loyalty to the Board by avoiding "loose talk."

CORRESPONDENCE

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents.

Appliance Testing

I WAS very interested in the note on Appliance Testing in your current issue and fully agree with your opinion that it is much better to have a single standard of acceptance rather than a conflict of opinions in different areas. Although Mr. W. R. T. Skinner agrees that appliances ought to be tested I do consider that his suggestion that there should be a number of testing houses is not a progressive move and is against the principle of standardization.

For many years the electrical industry suffered considerably through having many difficult wiring rules and regulations embodying the varied ideas and idiosyncrasies of so many central station engineers whose fads were law in their own areas. The industry has had quite sufficient of such crippling and irritating practices without starting similar ones in connection with appliance testing.

Going back some fifteen or sixteen years: in a speech I made at a dinner of the Bradford Branch of the E.C.A. I said "I would like to see a national proving house for electrical apparatus established and a stipulation made that no apparatus should go on to any installation which had not passed the requirements of that proving house." This was greeted with loud applause by a company of about a hundred electrical men and I think it was the first time a national proving house was suggested for the industry.

I am still firmly of opinion that the job is for one national body. This would be far better for everyone concerned, manufacturers, wholesalers, retailers and users and, of course, not forgetting that giant that has, in my opinion, unfortunately raised its head amongst us, the B.E.A.

Bradford. HARRY MOSS,
M.I.E.E., F.I.E.S.

Science in 1851

WHEN he read a paper at a meeting of the Birmingham Electric Club on Monday last, Sir Henry Self, deputy chairman (administration) of the British Electricity Authority, dealt at some length with the status of science in 1851. He said that such progress in scientific achievement had been made during the sixteenth, seventeenth and eighteenth centuries, combined with the gradual establishment of the right of thought and independence of thought and practice, that the claims advanced in the early nineteenth century for the pre-eminent status of scientific knowledge found little effective resistance. Mechanism was then rapidly finding acceptance of all life and matter with the common creed drifting towards a scientific agnosticism supporting a pure materialism, itself waiting to be enhanced by the achievements of a utilitarian science.

This outlook made rapid progress during the century and came into full possession of the field with the Victorian doctrines of *laisser-faire* and utilitarianism with their ally mechanism as the vehicle of existence. Sir Henry felt that the illegitimacy of such an interpretation was manifest, however, when one appreciated the true status of scientific knowledge at that time. To illustrate this he summarized the stages reached in mathematics, physics, chemistry and biology respectively. In addition, he made reference to the general scientific outlook so ably focused in W. Whewell's "The Philosophy of Inductive Sciences" which was published in 1840.

PERSONAL and SOCIAL

News of Men and Women of the Industry

THE Nobel Prize for Physics this year has been divided between **Sir John Cockcroft**, of Harwell, and **Prof. E. T. S. Walton**, of Dublin University, for their work on the atom. Sir John is to give a lecture on his work before the Swedish Academy of Science on 2nd December.

Sir John Cockcroft

Prof. E. T. S. Walton

Major Richard Amberton, M.I.E.E., a director of the Dorman & Smith group of companies, left this week in the *Capetown Castle* to inspect the business of the group in South Africa.

Mr. H. H. Wall, formerly station superintendent at Padiham generating station, has been appointed station superintendent of the new Huncoat generating station. Mr. Wall, who served his apprenticeship with the Maidstone Corporation Electricity Department, is a member of the Institute of Fuel, and Associate of the Institution of Electrical Engineers. From 1922 to 1949 he held various positions with the Lancashire Electric Power Co., and was appointed superintendent at Padiham in 1949.

Mr. H. H. Wall

Mr. W. Blythe, B.Sc.(Eng.), A.M.I.E.E., who became station superintendent at Burnley in 1948, succeeds Mr. Wall at Padiham. His service with the electricity supply industry began in 1915 with the Cleveland and Durham Electrical Power Co., and he went to Burnley in 1926 as junior engineer, later becoming shift charge engineer. In 1940 Mr. Blythe was appointed station superintendent and technical assistant, a position which he held until vesting date.

Mr. M. Gaughan, B.Eng., A.M.I.E.E., F.I.E.S., has recently been appointed to the Government and Railways Department of the Lamp and Lighting Department, British Thomson-Houston Co., Ltd., at Mazda House, Fitzroy Road, London, N.W.1.

Mr. N. H. Barker, who recently retired from the post of district engineer, St. Helens District, No. 2 Sub-Area, Merseyside and North Wales Electricity Board, received gifts at a dinner given in his honour. The presentation was made by Mr. S. C. Harling.

Mr. W. R. Jones, who joined the Nevelin Electric Co., Ltd., from Lancashire Dynamo & Crypto (Mfg.), Ltd., an associated company, in January of last year, has now been appointed chief engineer. Mr. Jones was educated at the Manchester College of Technology and served his apprenticeship in the Trafford Park Works of L.D.C. Subsequently he spent a year in the General Contracts Department at the same works and was then transferred to the Planer Department. In 1947, whilst still in this Department, he took over the handling of all the "Varionic" drives which, because of the size of equipment, required the association of Trafford Park motors with Nevelin rectifiers.

Mr. W. R. Jones

Mr. R. Childs, M.I.Ex., since 1939 export manager of Thorn Electrical Industries, Ltd., has left the company and is making a tour via Pakistan, India, Ceylon, Malaya, Australia and New Zealand, after which he will remain permanently in Australia where he will act as a marketing consultant for domestic appliance, radio component, electrical, lighting and associated manufacturers. He will be

covering New Zealand and Indonesia as well as Australia. His address is c/o Harold Yates & Son, 54, Oxford Street, Sydney, Australia.

Because of the great difficulty of finding fresh sources of power in such countries as Israel, resources which may normally be uneconomical elsewhere have to be taken into account. Industrial concerns at home which are developing equipment for the generation of wind power will accordingly be interested to learn that Educational, Social and Cultural Organization (U.N.E.S.C.O.) as the United Nations part of its programme of assistance to smaller nations has asked **Mr. E. W. Golding** to advise, on its behalf, the Government of Israel on the best methods of exploring the potentialities of wind power for electricity generation in that country. The Electrical Research Association has granted Mr. Golding leave of absence in order that he may accept the U.N.E.S.C.O. invitation.

Mr. E. W. Golding

The Edison Swan Electric Co., Ltd., announces that as from 30th November next **Miss Nora E. Miller** is resigning her position as manager, Publicity Department. Miss Miller's resignation results from a long period of ill-health. She is now making satisfactory progress towards recovery after a prolonged course of hospital treatment. Miss Miller has been manager of the Publicity Department of the company for twenty-four years and will be retained for consultation as required.

Mr. McK. E. Tatchell is appointed manager, Publicity Department of the Edison Swan Electric Co., as from 1st December, in succession to Miss Miller. Mr. Tatchell is now assistant advertising manager to British Overseas Airways Corporation. Before going East he was with Saward Baker & Co., Ltd., and in 1934 was appointed art director to D. J. Keymer & Co., Ltd., India. During the last war he served as major in the Indian Army.

Miss Nora Miller

Mr. McK. E. Tatchell

Mr. J. Cleland has been appointed engineer-in-charge of the television transmitting station which is now being built at Kirk o' Shotts between Glasgow and Edinburgh. Mr. Cleland joined the staff of the Glasgow station of the B.B.C. in 1931, transferring to the Scottish Regional station at Westerglen in the following year. In 1936 he was transferred to the London television station at Alexandra Palace where he remained until 1938 when he returned to Westerglen. In 1950 he became assistant engineer-in-charge, Westerglen, and for the last few months he has been acting engineer-in-charge. Mr. Cleland's assistant at Kirk o' Shotts will be **Mr. W. L. Nicoll**, who is at present one of the senior engineers at the Skelton short-wave transmitting station.

Mr. P. W. Painter, M.I.R.S.E., director and general manager of Metropolitan-Vickers-G.R.S., Ltd., retired on 30th September and **Mr. J. C. Kubale**, A.M.I.Mech.E., Assoc.A.I.E.E., M.I.R.S.E., has been appointed manager from 1st October. Mr. Painter received his early training at McKenzie & Hollands, Worcester. In 1912 he joined the Signal Department of the Bombay, Baroda & Central Indian Railway and was appointed acting signal engineer a year later. Early in 1914 he returned to England and joined the Austin Motor Co. and later, Crossley Motors. In 1918 he transfered to the Signal Department of Siemens Bros., Woolwich, where for five years he was in charge of the sales and contract work, including the installation of the one-lever route system of control on the driverless trains of the Post Office underground railway. In 1928 he joined Metropolitan-Vickers-G.R.S., Ltd.

Mr. J. C. Kubale

Mr. Kubale was born in Melbourne, Australia. He studied at Melbourne Technical College and was apprenticed to the Signalling and Telegraph Department of the Victorian Railways. From 1925 to 1928 he continued his technical training in the United States. He then returned to Australia where he was appointed an assistant engineer on electric traction work in the Chief Electrical Engineer's Department of the Victorian Railways. In 1930 Mr. Kubale joined Metropolitan-Vickers-G.R.S. in London and for the

ext nine years was engaged in engineering ork for marshalling yards and railway ignalling. During the war he served as a ajor in the Royal Engineers; he was awarded he M.B.E. for services in the Western Desert ampaign. Returning to Metropolitan-Vickers-.R.S. after the war, Mr. Kubale was ppointed chief engineer in October, 1945. He a member of the Council of the Institution f Railway Signal Engineers.

At a recent meeting of the Council of the radford Industrial Safety and Welfare ssociation, **Mr. P. Evans**, general manager, nglish Electric Co., Ltd., Thornbury, Brad-ord, was elected president. The hon. easurer is **Mr. E. Bastow** (English Electric o., Ltd.).

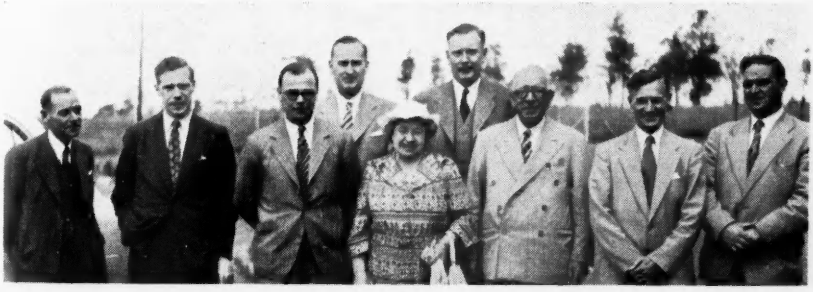
Mr. J. E. Whittaker has been appointed anager of the North of Scotland Hydro-Electric Board's Aberdeen Area in succession to Mr. A. Gardner who is retiring on 31st December. Mr. Whittaker, who is at present eputy manager, went to Aberdeen in 1937 and has held the positions of substations engineer and assistant distribution superintendent, chief technical assistant and deputy city electrical engineer. He became deputy area manager when the undertaking was vested in the North of Scotland Hydro-Electric Board. Before going to Aberdeen, Mr. Whittaker was with the Bradford Corporation Electricity Supply Department. Mr. Gardner has been in charge of Aberdeen's electricity undertaking since 1937, and joined the undertaking in 1912 as a junior engineer.

The following new appointments are announced by Philips Electrical, Ltd. :—**Mr. N. D. Houston** has been appointed regional manager of the Glasgow branch following the resignation of Mr. W. J. Harris. Mr. Houston was previously branch manager at Cardiff, and joined Philips as a lighting engineer in 1944. **Mr. W. L. Hay**, the company's radio representative in Eastern Scotland, has been appointed manager for radio and television as from 1st November for the whole of Scotland and is responsible to the new regional manager, Mr. Houston. **Mr. J. Jordan** has been appointed Cardiff branch manager in succession to Mr. Houston. Mr. Jordan has been with Philips Electrical, Ltd., since 1929, except for his war service as a flight-lieutenant in the R.A.F.V.R. For the past three years he has been sales manager for "Philidyne" cycle dynamo lighting sets. **Mr. K. A. Bromley**, lighting sales engineer at Philips Leeds branch, has been appointed as assistant to the regional manager of the Manchester branch (Mr. H. Morehouse).

Mr. W. H. C. Pilling, B.A.(Cantab.), M.I.E.E., generation engineer (construction) of the southern group of power stations in the Yorkshire Division of the British Electricity Authority, has been appointed chief generation engineer (construction), Merseyside and North Wales Division. Mr. Pilling served his apprenticeship with Hathorn, Davey & Co., Ltd., Leeds, and the Imperial Continental Gas Association, with which, for a period, he was employed as assistant resident engineer at the Droogenbosch power station, Brussels. In 1928, he joined the Yorkshire Electric Power Co., and served with that company for twenty years, first on the erection of overhead transmission lines and later as chief assistant to the power station construction engineer. With the establishment of the British Electricity Authority in 1948, he was appointed deputy generation engineer (construction) of the central group of power stations of the Yorkshire Division, and a year later took up his present position.

The accompanying picture was taken during the recent visit to the factory of **Scottish Cables (South Africa), Ltd.**, Pietermaritzburg, of Mr. William Fraser, senr. (chairman of Scottish Cables, Ltd., Renfrew), Miss Margaret Fraser and Mr. William Fraser, junr., together with the directors and area sales managers.

Front row (*left to right*): **Messrs. W. E. L. Tonkinson, N. N. Lunt (director), W. Fraser, junr. (director), Miss Margaret Fraser, Messrs. Fraser, senr. (chairman), D. G. Sutherland (director) and J. C. Sutherland (director). Back row: Mr. A. C. Grant and Mr. J. Jeans**



Mr. H. P. Thompson, who for the past five years has been commercial manager of Flinders (Wholesale), Ltd., has been elected to the board of the company.

Prof. M. S. Thacker, M.I.E.E., Principal of the Institute of Science, Bangalore, India, is in London for a few days and friends can get in touch with him through the High Commissioner for India.

On 15th, 16th and 17th November the Amateur Dramatic Section of the Victoria Works Athletic Club of **Johnson & Phillips, Ltd.,** presented "On Monday Next," a farce by Philip King. The play was produced by S. D. Cantle.

At a dinner of **The Dynamicables** held at the Café Royal, London, W.1, on 14th November, Mr. H. Nimmo, chairman of the Southern Electricity Board, was in the chair and suitably responded to the toast of his health proposed in a witty speech by Mr. H. J. Randall, chairman of the London Electricity Board.

On 26th October ninety-five employees, both staff and works, of **Siemens Brothers & Co., Ltd.,** were presented by the chairman of the company, Sir Hubert de la Poer Gough, with certificates for having completed forty years' or more service with the company. Others present included the managing director, Mr. F. A. Lawson, M.I.E.E. (who received one of the certificates), Mr. G. W. Giffin, M.B.E., director and general works manager,

Gen. Sir Hubert Gough presenting a long service certificate to Mr. H. J. Probert, who has completed fifty-six years with Siemens

and Mr. S. W. Lumb, F.A.C.C.A., secretary of the company.

In making the presentations Sir Hubert referred to the fact that the suggestion for these certificates had come from the representatives of the employees through the Co-operation Committee. The company's success was in no small measure due to long service employees and he conveyed the company's welcome to them and also its thanks for their sterling work over so many years. Mr. W. Grinsted, M.B.E., chief engineer of the Telecommunications Department, moved a vote of thanks to Sir Hubert and the company, and Mr. H. Hughes (Woodworking Department) seconded.

The **Ekco Dramatic Society** presented the comedy "The Young Mrs. Barrington" to full houses during the week commencing 5th November in the Ekco Works Theatre. The play was produced by Mr. Fred Bowles and interval music was provided by the Ekco Theatre Orchestra under the direction of Mr. R. K. Spencer.

Long-service awards were recently presented by Sir Harold Wernher, chairman of **Ericsson Telephones, Ltd.,** to thirty-five employees who have completed twenty-five years' service with the company.

About two hundred of the staff and friends of **Collins Electrical, Ltd.,** gathered at the Ardington Rooms, Clapham Junction, on Friday last for the company's annual dinner and dance. Mr. C. E. Collins, chairman, presided. Reference was made in the after-dinner speeches to the loss of the founder of the firm, Mr. C. F. Collins, A.M.I.E.E., which occurred earlier in the year. Included in the many toasts was a special one to a member of the staff who had recently returned from Korea. Dancing and an excellent cabaret followed.

OBITUARY

Mr. H. L. McMichael.—The death occurred on 17th November at Harley Street Nursing Home of Mr. Hubert Leslie McMichael, M.I.E.E., M.Brit.I.R.E., chairman and joint managing director of McMichael Radio, Ltd.

Mr. Herbert Finnis, O.B.E., chief electrical engineer, cable ships, Eastern Telegraph Co. (Cable & Wireless, Ltd.), and H.M.S. *Bullfinch*, died on 19th November at the age of sixty-eight.

WILLS

Mr. A. E. Felton, managing director of the Revo Electric Co., Ltd., who died on 13th July last, left £40,017 gross (£38,436 net).

Mr. W. P. Lilwall, A.M.I.E.E., for over twenty-five years borough electrical engineer at Fleetwood, who died on 9th February last, left £4,497 gross (£4,441 net).

Mr. F. S. Holder, a member of the London office staff of the Metropolitan-Vickers Electrical Export Co., Ltd., 1923-1949, who died on 6th June last, left £9,845 gross (£9,776 net).

PARLIAMENTARY NEWS

From Our Special Reporter

IN the House of Commons last week Mr. Blenkinsop asked the Minister of Works whether he would take steps to ensure that all portable gas and electric fires were fitted with guards to help reduce danger to children.

Mr. Eccles said that guards were included in the specifications for these fires recently published by the British Standards Institution. The manufacturers' associations had promised his department to urge their members to observe the new specifications.

North Atlantic Cable

Mr. Hobson asked the Assistant Postmaster General when work would commence on reconditioning the old North Atlantic cable at present not in use.

Mr. Gammans said he understood from Cable & Wireless, Ltd., that the reconditioning of the old cable from Portheurno to Harbour Grace was planned to commence in June, 1952, if sufficient cable was then available.

New Telephones

Mr. Winterbottom asked the Assistant Postmaster General if he would state the total number of telephones installed during the 12 months ended 30th September, 1951; and to what extent it was intended to maintain this rate of installation.

Mr. Gammans said the figure was 344,190. The Postmaster General intended to maintain as high a rate of installation as the resources, and the requirements of the defence programme, would allow.

Television

Mr. Awbery asked the Assistant Postmaster General what progress was being made with the television transmitting station now being erected to serve the South West Region; and at what date he expected it to be ready for transmission.

Mr. Gammans said that the B.B.C. informed him that work on the television station at Wenvoe had gone ahead according to schedule, but in view of the present uncertain supply position it was too early to say whether it would be ready to transmit programmes by the middle of 1952 as planned.

Mr. George Thomas was told that the estimated cost of the Wenvoe station was £330,000. All orders for equipment had been placed.

Mr. Gammans also said that the laying of the cable connecting the Wenvoe transmitter was almost complete and the equipment to be associated with it was being installed. The cable would not be ready for service before November, 1952, but by about the middle of next year they expected to be able to provide a radio link for temporary use.

In reply to questions by Mr. Grey, Mr. Gammans said that the estimated cost of the radio television link between Manchester and Kirk o' Shotts was about £520,000; cable was not being used. The estimated cost of the station at Pontop Pike, the erection of which had been postponed, would be in the region of £150,000 to £200,000.

Answering Mr. Popplewell, Mr. Gammans said that when a television station was provided for the north-east it was intended to connect it to the Manchester–Kirk o' Shotts radio link which passed through Pontop Pike.

Mr. Gammans told Mr. Slater that three applications had been received for licences to permit relay television in the area covered by the proposed transmitter at Pontop Pike.

Scottish Board's Borrowing Powers

The Hydro-Electric Development (Scotland) Bill was introduced into the House of Commons last week by Mr. J. Stuart, the Secretary of State for Scotland, and formally read a first time. Its purpose is to raise the limit on the amount of borrowed money which the North of Scotland Hydro-Electric Board may have outstanding at any time (apart from money borrowed to meet the compensation paid to undertakers whose undertakings vested in the Board under the Electricity Act, 1947) from £100 million to £200 million.

Loans raised by the Board may be guaranteed by the Treasury. Any charge which may arise on the Consolidated Fund by the giving of guarantees is repayable by the Board. No charge has so far fallen on the Consolidated Fund.

Locomotives in Mines

Mr. Peter Freeman asked the Minister of Fuel and Power if he would state the number of 10-ton locomotives now used below ground in mines; and what encouragement of the use of electric battery and diesel locomotives of this and smaller weight for haulage in mines at or near the coal face had been officially given by his department.

Mr. Geoffrey Lloyd said that the latest available figures related to 31st December, 1950, when there were 313 locomotives of 12 tons weight or less used below ground in coal mines. The installation of locomotives in coal mines

was a matter for the N.C.B., which must have regard to the layout of the mines, the size and gradients of the roads, the safety with which they could be used and other factors.

Supply to Borrowdale

Mr. Frederick Peart, the Labour Member for Workington, raised the question of the supply of electricity to Borrowdale. One of the most formidable arguments for the nationalization of electricity was that areas such as Borrowdale could be treated as special cases. A scheme was prepared fourteen years ago, but it was vigorously opposed and aroused considerable controversy on the amenity issue. But Borrowdale had a right to enjoy those basic services which were essential to the well-being of a modern community. The time had come to review the whole position.

Mr. W. M. F. Vane (Conservative) supported the appeal.

Mr. Joynson-Hicks, the Parliamentary Secretary to the Ministry of Fuel and Power, replying, while sympathizing with the case put forward, said that it was for the North Western Electricity Board to decide about the supply of electricity to this particular area. The Board was particularly anxious to fulfil its duty of bringing electricity to the rural areas, but at present the limitation on capital expenditure made it impossible.

Protection of Consumers

Major Anstruther-Gray asked the Minister of Fuel and Power if there was any way in which consumers could protect themselves against being fined for offences for which they were in no way responsible, as had happened in Yorkshire.

Mr. Lloyd said he would like to see that question on the order paper.

Copper and Zinc Ban

AN Order made by the Ministry of Supply (S.I. 1960) banning the use of copper, zinc and their alloys for a number of purposes came into force on 20th November. It is provided, however, that manufacturers holding partly processed copper or zinc parts may use them until 1st February. In future no licences will be issued for making the specified items for exportation to other member countries of the O.E.E.C.

The Order covers electrical and gas equipment, fittings, accessories and appliances of the following descriptions:—

Flashlight cases (except contact points for carrying current); portable electric lamps and lanterns (except current carrying parts); permanent wave equipment (except current carrying parts and replacement parts); hair dryers (except current carrying parts, bearings and bearing housings and replacement parts); vibrators (except current carrying parts bearings and bearing housings); electric hair clippers and shavers (except current carrying parts and bearings).

Household appliances using electricity, gas or solid and liquid fuel (except current carrying parts and bearings and bearing housings) of the following descriptions:—Bedwarmers and airers, curling tong heaters, curling and waving irons, dishwashing machines, drying cabinets, drying machines, egg boilers, floor polishers (except shaft distance pieces), fans (except gears), footwarmers, fruit juice extractors, glue pots, health exercisers, hotcupboards, immersion heaters, irons and ironing machines, milk heaters and porringers, motor car heaters (other than heaters designed solely for heating motor car engines or radiators, or for the de-misting or de-frosting of motor car windscreens), razors, sealing wax heaters, shoe polishers, teapots and tea-makers, tie and trouser pressers, toasters, vacuum cleaners (except shaft distance pieces and cylinder end rings), warming plates, washing machines, and wringing machines.

Glasgow Transport Plan

TO help to solve Glasgow's transport problem a railway electrification plan for the Clyde Valley costing £10,236,540 is proposed. It is contained in a report by the Glasgow and District Transport Committee to the British Transport Commission, and provides for the electrification of most of the suburban and inter-urban lines. It is estimated that 70,000 tons of coal a year would be saved and that the capital outlay would be justified by increased revenue and reduced operating costs. The scheme includes eleven new halts and a new link from the King's Park line to the Circle line. Other recommendations of the Committee are that all corporation tram and bus services outside the city boundary should be discontinued and replaced by services provided by the Railways and the Scottish Bus Group and that tramways throughout the city should be replaced gradually by buses.

New Signalling at Whitechapel

LAST Saturday the existing locking frame in the signal box at Whitechapel (District Line) was taken out of commission and replaced by a new 47-lever locking frame with miniature levers of the full-stroke type. At the same time a new relay room was brought into use alongside the signal box. The signalling at Whitechapel was about forty years old. The new power frame will control modern signal and point equipment on the track; new signals will be of the two-aspect colour light type, with junction indicators. Existing d.c. track circuits will be superseded by a.c. condenser-feed type track circuits marking the passing of the last of London Transport's d.c. signal boxes.

Plant for Canada

Fourth Turbo-Generator for Windsor, Ontario

A CONTRACT for the manufacture of a hydrogen cooled steam turbo-alternator has been awarded to the English Electric Co., Ltd., for installation in the J. Clark Keith generating station at Windsor, Ontario.

Together with three similar sets of the same make, the fourth will raise the total capacity of this plant to 264 MW. The first set, which has already steamed, was put into operation for the official opening of the station on 16th November when Sir George Nelson, chairman and managing director of the English Electric Co., was present at the ceremony.

Windsor is an industrial city on the River Detroit and the Keith project is part of an important programme of thermal power development which the Hydro-Electric Power Commission of Ontario embarked upon to supplement electricity production in the Province, mainly by backing-up the generating capacity of hydro-electric stations when water shortage reduces their outputs, or when hydro-power is insufficient to meet peak demands.

When completed in 1953 the Windsor station will be the second largest steam driven electricity generating plant in Canada. It is one of two new large steam stations to be taken into service this year by the Hydro Commission.

The idea of installing steam plant in the middle of a large water power system, such as exists in south-west Ontario, is not new. Among the principal reasons why nothing was done for 20 years was the proposed St. Lawrence waterway scheme, about which agreement was needed between Canada and the United States.

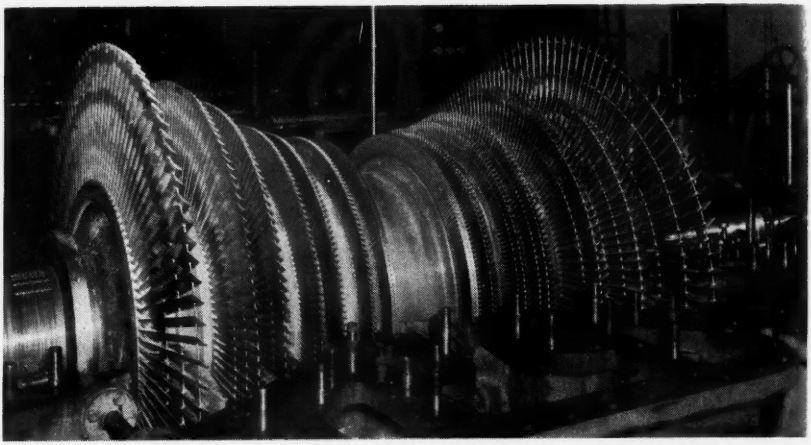
Alternator stator weighing 130 tons being loaded into a ship for delivery in Canada this year

During the war, however, rapid industrial expansion occurred in Toronto, indeed throughout the whole of south-west Ontario, as a result of which the Hydro Commission was faced with a power shortage which in some respects was more severe than the similar conditions which have been experienced in Great Britain.

Water power development schemes were launched in 1945 and some of them are still unfinished. There is, however, an economical limit to the use of water, particularly in northern Ontario and other areas of reserve water, due to inaccessibility of the source and the economics of high voltage transmission over very long distances.

These and other considerations turned the serious attention of the Hydro Commission to the use of steam near to the heavy demand areas. One of the latter is Windsor, which is situated opposite Detroit, so negotiations for building the station were commenced in 1947 and orders were placed for two units early in 1948.

The turbines and alternators were built in the company's works at Rugby. Each is of 48,000 kW (m.c.r.) with a " capability rating " of 66,000 kW, designed to run at



View of low pressure shaft with blading in position for one of the two-cylinder turbines

3,600 r.p.m. with steam at 850 lb/sq in and 900 deg F (900 lb/sq in and 915 deg F max.) and to exhaust into 28½in Hg vacuum when carrying 60 MW load.

The two-cylinder turbine is of the company's usual design, consisting of an impulse high pressure cylinder and a double flow reaction low pressure cylinder. This combination offers the advantages of a robust rotor and ample running clearances at the high pressure end where the flow areas are small and pressure and temperature more severe, together with greater hydraulic efficiency of reaction blading at the low pressure end where areas are large and leakage losses proportionately smaller.

Steam is supplied through two stop valves to two cast steel chests arranged symmetrically about the turbine, each chest having a combined main stop and emergency trip valve. A separate cast steel chest is welded on to each main chest and carries the main throttle and overload valves. The chests operate in parallel, each main throttle valve being connected to the turbine by two pipes and each overload valve by one pipe. This arrangement ensures that pipe thrusts generally cancel out.

The h.p. rotor is machined out of a solid forging and the diaphragms in the h.p. cylinders are of built-up construction. The double flow l.p. rotor is a solid forging, except for a separate disc shrunk and keyed on at each end to carry the last rows of blades.

The couplings throughout are of the multi-tooth flexible type with generous axial float and, as the h.p. turbine has its own thrust block, differential expansions are confined to each individual cylinder. The h.p. turbine thrust block can be moved by a small amount in an axial direction while the turbine is in operation so that the effects of differential expansions during starting or unloading periods can be minimized. With the same object in view when starting, the flanges of the h.p. cylinder are provided with controllable steam heating.

The blading is of stainless iron or chromium plated 5 per cent manganese nickel steel, depending on the stress conditions. The blade fixings are of various types; the long blades of the last row at each end of the l.p. turbine are of the " side entry " type, each root being held in a separate groove in the disc head, cut across the head in an approximately axial direction. The effect is that bending stresses are avoided, both in the blade root and in the disc head, so that the total resultant stress is reduced.

The glands throughout are of the labyrinth type, steam packed, leakage steam being conducted to lower pressure stages of the turbine where it performs useful work. The vacuum glands of the l.p. turbine are packed with steam from the h.p. cylinder at a moderate temperature. During starting and stopping the glands take steam suited to their temperature at the time.

A hydraulic oil pressure system of governing and load regulation is employed. The emergency gear is actuated by a mechanical overspeed governor of the unbalanced ring type, by an electrical overspeed governor, by hand trip at the turbine, or by an electrical trip from the control room. The lubrication pump is in the l.p. pedestal and is driven from the main shaft through helical gearing. In addition a steam driven auxiliary oil pump and an a.c. motor driven oil pump are provided.

As it is intended to uncouple the generator and to run it as a synchronous condenser under certain conditions of load on the system, two further lubricating oil pumps (one with a.c. drive and one with d.c. drive) are provided.

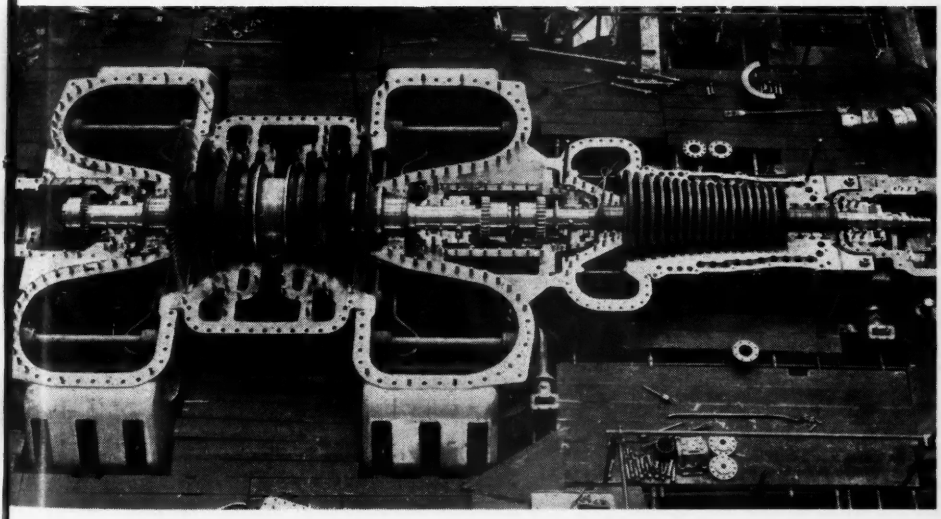
Electrically driven barring gear is provided to reduce any risk of the turbine rotors distorting due to uneven heating or cooling while the set is shut down. It turns the rotors at about 20 r.p.m. and is put into operation by hand, but is thrown out automatically when the turbine speed under steam exceeds that of the gear. High pressure oil jacking of the l.p. turbine and alternator bearings ensures that each is supported by a continuous oil film before barring commences, so that the starting effort of the motor is reduced.

To obtain close control during starting and shutting down periods, supervisory instruments include: (i) an electrical indicator, in addition to the usual mechanical tachometer, which indicates and records the speed from about 100 r.p.m. upward by calibrating the output from an induction tachogenerator driven from the main turbine shaft; (ii) shaft eccentricity as well as (iii) shaft position, or axial differential expansion, indicators and recorders operating on the principle of introducing the distance to be measured as a variation in an air-gap controlling the reactance of an inductive circuit; (iv) a h.p. pedestal expansion indicator whereby displacement initiates movement (through a lever arm) of an iron core sliding within two solenoids to vary the relative values of two inductances in a bridge circuit; and (v) vibration pick-up heads on the bearing pedestals to measure transverse amplitude.

Vacuum load limiting gear will unload the set gradually by action on the governor gear, should the vacuum fall, while there is provision for admitting dry saturated steam to wash away any deposits formed in the turbine.

The alternator is hydrogen cooled and generates at 13·8 kV 3-phase, 60 c/s. The stator frame is a fabricated structure,

Bottom half of 60 MW steam turbine with (left) low pressure and (right) high pressure shafts in position



ribbed and stayed internally, designed to be "explosion safe."

The stator core is built up from segmental stampings carried in a skeleton frame inside the main stator frame by flexible leaf springs. Any vibration that is produced by magnetic attraction between the poles of the rotor and the stator core is thus largely prevented from being transmitted to the main structure and the foundations, while at the same time the core is rigidly restrained against the load and short circuit torques. The two gas coolers are mounted axially in the upper part of the outer frame and the gas is circulated by axial flow fans with blades of aerofoil section, one fan being mounted at each end of the rotor. This construction eliminates all external ducting and thus simplifies maintaining a gas-tight enclosure.

The rotor is conventional; it has a multi-tooth flexible coupling and ventilation channels beneath the slots and down the centres of the teeth. As the result of cutting the slots to contain the field winding, the inertia of the rotor is different across the two major axes, so that the static deflection at the centre of such a long rotor is appreciably greater when the pole axis is horizontal than when it is vertical. This causes vibration of the rotor at twice the running frequency, which is minimized by transverse grooves machined in the pole centres.

The field winding is formed from semi-hard silver-bearing copper to prevent coil distortion through differential thermal expansion. The turns are taped throughout their length with glass-backed mica tape and the leads are brought out of the gas-tight housing by means of semi-circular conductors running through the central inspection hole of the forging to the sliprings.

Excitation is by an exciter running at 1,000 r.p.m. and driven through gearing from the main alternator shaft.

Leakage of hydrogen along the shaft is prevented by oil sealed glands of the floating ring type. The oil is normally vacuum treated to remove entrained air and water that would adulterate the hydrogen. The treating unit is at basement floor level within the foundation block and contains the auxiliary equipment associated with the oil supply to the seals.

Census of Production

Lighting Accessories and Fittings: Wires and Cables

FINAL reports on the 1948 Census of Production dealing with electric lighting accessories and fittings, and electric wires and cables, have been published by H.M. Stationery Office, price 2s net each.

The report dealing with electric lighting accessories and fittings shows that the number of larger establishments was 152, as compared with 64 in 1935, and in addition there were 67 small firms employing on average ten persons or less.

The gross output of the larger establishments in 1948 was £15,206,000, as compared with £2,143,000 in 1935, and after allowing for cost of materials and fuel used, and payment for work done on materials given out, the net output was £8,064,000 (£1,101,000). At the beginning of the Census year stocks of finished products and work in progress were valued at £1,911,000, and materials and fuel £2,151,000, while the figures at the end of the year had risen to £2,068,000 and £2,336,000 respectively.

The average number of employees in the industry in 1948 was 16,516, and included 13,564 operatives, 2,952 administrative, technical and clerical employees, and 16 working proprietors. In addition there were 32 male and 173 female outworkers. The aggregate of wages paid was £4,466,000 (operatives £3,193,000 and administrative, technical and clerical employees £1,273,000).

In the report dealing with electric wires and cables, the gross output of the 84 larger establishments in 1948 is shown as £99,194,000, as compared with £20,906,000 by 64 establishments in 1935, and after providing for cost of materials and fuel used, and payment for work done on materials given out, the net output in 1948 was £39,471,000 and in 1935 £9,064,000.

The value of stocks of finished products and work in progress at the beginning of the year was £13,102,000 and at the end of the year £16,759,000. Stocks of materials and fuel were valued at £11,278,000 at the beginning of 1948 and £12,529,000 at the end of the year.

Dealing with employment and remuneration in the industry, the report shows that the total number employed was 63,685, of whom 49,332 were operatives and 14,353 administrative, technical and clerical employees. In addition there were four male and 290 female outworkers. The total wages and salaries paid amounted to £19,378,000, operatives accounting for £13,885,000.

Building Exhibition

Accelerating Construction and Fuel-Saving the Main Themes

THE electrical industry is in a position to assist very considerably in solving two of the principal problems now facing the building industry: the speeding up of the housing programme and the most economical utilization of fuel resources. At the Building Exhibition, which is being held at Olympia, London, until 28th November, there can be seen not only every type of electrical aid now at the disposal of the builder and contractor, but also a number of exhibits showing the way to place and install electrical equipment in buildings so as to reduce fuel wastage.

E.D.A. Display

A striking and effective display has been arranged by the British Electrical Development Association, a large portion of whose stand is devoted to a full-scale section on two floors setting out a system in which hot water is produced by a back boiler incorporated in a slow combustion stove in the living room, the hot water storage tank being fitted with an immersion heater for use during the summer or when the fire is out in the winter.

The whole exhibit emphasizes the importance of correct pipe layout to prevent the waste of electricity due to unnecessarily long runs of piping. Supplementary display features indicate savings that can be made by lagging the tank, e.g., a 30 gall unlagged tank on circuit continuously wastes 342 gall of hot water a week, whereas with 3in of lagging the waste is reduced to 27 gall, representing a saving of 83 kWh a week.

The remainder of the E.D.A. stand consists of a two-storey house, half actual size, built in skeleton form, with full-size electrical equipment identified and explained by display cards. The complete house wiring scheme includes cabling for an electric cooker and water heater, a lighting circuit, and ring main wiring to an adequate number of 15 A fused plugs and sockets.

Further indications of the correct layout of electric space heating and water heating apparatus are given in the Ministry of Works exhibition, and both Hurseal, Ltd., and Fibreglass, Ltd., show jackets for lagging hot water cylinders. Improvement in appearance as well as efficiency has resulted from the recent re-designing of the "Sadia" wall mounting thermal storage type of water heater. With under-draining-board, coal, electric and self-contained cistern types, Aidas Electric, Ltd., also introduces the new "U" type immersion heater which is the first of its kind on the market, having a head screwed 1½in or 2½in B.S.P.T.

Electric space heating apparatus is represented only by fan heaters and oil filled radiators. Exhibitors of the former include Copperad, Ltd., Flexaire, Ltd., and Hurseal, Ltd. The last-mentioned company, together with Steel Radiators, Ltd., and Dimplex, Ltd., show radiators. Electric clocks, including time recorders operated and controlled by a pendulum master clock independent of the a.c. supply and not affected by power cuts are displayed by English Clock Systems, Ltd. The Staines Kitchen Equipment Co., Ltd., demonstrates a dish washing machine.

On the constructional side, there is a very large array of concrete mixers, vibrators, hoists, winches, chain blocks, etc. E. P. Allam & Co., Ltd., have brought out an extra-high-frequency electric internal vibrator of new design, and A.C.E. Machinery, Ltd., now has a special purpose passenger/goods hoist (for constructional contracts, up to 450ft high) incorporating new automatic safety features, governing gear and cage brake.

Metal- and Wood-Working Machines

A tube bender (Hilmor, Ltd.) and a bar cropper (E. P. Allam & Co., Ltd.) are interesting metal-working machines. Appliances for wood working cover almost every conceivable requirement and one versatile machine made by S. Tyzack & Son, Ltd., includes in its "repertoire" such operations as grooving, moulding, planing, cross-cutting, boring, rebating, rip-sawing, mitreing, surfacing, ploughing, bevelling and tongueing. Among other machines are dowel pointers and cutters,

plywood presses, veneer jointing guillotines, saw sharpening machines, knot boring and plugging machines, dovetailers and cluster boring machines.

An orbital sander and a router which does grooving, moulding, routing and rabbeting in wood and metal alloys are two new portable tools introduced by S. N. Bridges & Co., Ltd., another new router, the " Centec Senior," being shown by the Central Tool & Equipment Co., Ltd. Kango Electric Hammers, Ltd., demonstrate a full range of electric hammers and tampers, and the Consolidated Pneumatic Tool Co., Ltd., includes electric as well as pneumatic tools in its display.

The new " Supa-dynamic " plug driving gun, made by F. H. Bourner & Co. (Engineers), Ltd., is claimed to be the fastest tool of its kind in the world; it is self-ejecting and sets four plugs a minute in steel, wood, R.S.J. and various types of concrete. " Secomak " industrial vacuum cleaners, suction and blowing equipment; Barlow-Whitney electrically heated glue pots; Martindale paint sprayers; Tarpen portable planes; and various Black & Decker products are among a comprehensive display of portable electric tools shown by E. K. Cole, Ltd. Portable generating plant made by Arthur Lyon & Co. (Engineers), Ltd., supplies electricity where no mains supply is available.

Flexible shaft tools can be seen on the stands of the Flextol Engineering Co., Ltd., B. O. Morris, Ltd., and the Flexible Drive & Tool Co., Ltd. Romac Industries, Ltd., show portable compressors, and Volspray, Ltd., spray painting equipment. Floor treatment, covering sanding, planing, scrubbing, drying, sweeping and polishing, can be carried out by one or other of the machines made by Nufloor, Ltd., Cimex-Fraser Tuson, Ltd., and R. G. Dixon & Co., Ltd.

An attractive display by G. A. Harvey & Co. (London), Ltd., indicates the rapidity, efficiency and saving of labour provided by the " Harco " method of fixing cables to concrete and steel structures.

Conserving Scarce Materials

IN the summer of this year a party of specialists from this country visited the United States, under the auspices of the Anglo-American Council on Productivity, to study methods of saving scarce materials. The leader was Sir Graham Cunningham, chairman and managing director of the Triplex Safety Glass Co., Ltd., and the party included Mr. H. W. Bowen, managing director, E.M.I. Factories, Ltd. (sponsored by the British Electrical and Allied Manufacturers' Association), and Mr. Vincent Everard, works executive director, Belliss & Morcom, Ltd. (sponsored by the British Engineers' Association).

Discussions with American industrialists led to the conclusion that great progress had been made recently in the United States in the use of very low alloy or plain carbon steels containing small additions of boron, mainly for components of small section. The shortage of some non-ferrous metals in the United States appears to be already impeding production. Aluminium and magnesium show considerable prospects of rapid expansion and should replace some scarce non-ferrous metals. Vigorous short-term conservation measures are being taken, particularly with nickel, lead and tin. These measures deserve further study by interested British industries.

Conservation of plastics and their use as alternatives to metals do not appear to have made substantially greater progress in America than in the United Kingdom. Reference is made to the use of plastics instead of lead in the sheathing of light-duty electric cables. Three interesting new developments are the replacement of the lead sheath by one of corrugated aluminium covered by extruded layers of polybutene and polyethylene; an outer lead sheath of reduced thickness over polyethylene insulation; and a similar combination using steel in place of lead.

Alternative types of solders are mentioned in the report, as are substitutes for galvanizing (including the use of aluminium) and revised specifications for nickel and cadmium plating, etc.

Three new British techniques are of considerable interest to American industry and should be made more widely known in the United States. They are the electro-deposition of combinations of tin-zinc and tin-nickel; the use of ceramic-tipped cutting tools; and the use of precision-cast milling cutters.

The re-design of manufactured products with particular regard to the conservation of scarce materials is recommended as a continuous activity.

Copies of the report, " Saving Scarce Materials," can be obtained at 2s each (including postage) from the Anglo-American Council on Productivity, 21, Tothill Street, London, S.W.1.

Valve Cathode Life

Causes of Failure

At a meeting of the Radio Section of the Institution of Electrical Engineers in London last week a paper dealing with the life of oxide cathodes in modern radio receiving valves was presented by Dr. G. H. Metson, Dr. S. Wagener, Mr. M. F. Holmes and Mr. M. R. Child. The authors, who are all at the Post Office Research Station, Electronics Division, attempt to integrate all the information on oxide cathodes which may have a bearing on life span. Original research results are included, in addition to published work from other sources.

Two broad problems are distinguished as pre-requisites to effective control of valve quality from the aspect of longevity. First of all, production processes must be more clearly understood in order that they may be closely related to valve life, and, secondly, a short-term method for assessing valve life must be developed.

In considering a solution to the first problem functional failure and cathode failure are recognized as the two main causes of valve faults. Only the latter is considered in detail and this is subdivided into failures due to gas attack, to excessive interface feedback and to excessive evaporation of the activated cathode.

The authors describe production processes which have been developed on a laboratory scale by the Post Office. These go far toward excluding gas attack and have enabled valves to be produced which have shown no deterioration in total emission after 10,000 hours of use. Interface feedback is identified with impurities in the core and control of the impurity concentration may set a limit to the magnitude of the feedback. Cathode evaporation may be reduced to negligible amounts in gas-free valves by a reduction in the running temperature which also brings about a considerable saving in heater power.

The efficacy of these attempts to avoid valve failure is judged by the short-term methods for assessing valve life which are advanced as solutions of the second broad problem. These take the form of short life tests making use of total-emission measurements and a.c. measurements of interface resistance; the authors express the opinion that the latter is likely to become one of the most important valve measurements in the future. The more usual measurements of space-charge-limit mutual conductance are used in correlation with newer tests.

In conclusion, the authors show that most present-day valves fail from functional causes, from gross emission deterioration due to gas attack or from the growth of excessive interface feedback. If these phenomena are avoided by greater skill in mechanical design, by adequate gas scavenging and by the use of a cathode core capable of producing no interface resistance, then the authors are of the opinion that the life of the valve will probably be limited only by evaporation of the activated oxide.

Large Pumping Stations

THE design of large pumping installations was the subject of a paper presented by Messrs. G. A. Wauchope and H. P. Humphreys (Gwynnes Pumps, Ltd.) to the Hydraulic Group of the Institution of Mechanical Engineers. The purpose of the authors was to focus attention on the factors which must be investigated when deciding upon the layout of the larger sizes of pumps for low and medium heads.

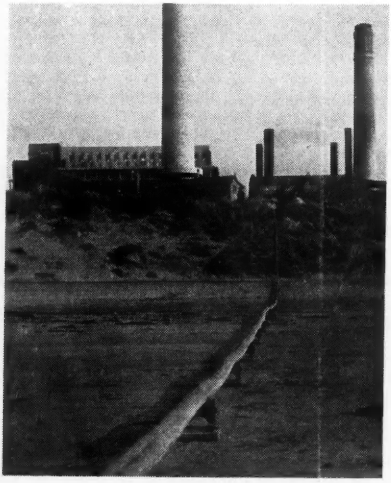
The paper assessed the merits of various types of pumps in accordance with their physical shapes and their hydraulic characteristics from the point of view of first cost and maintenance expense together with the cost of energy consumed, because when the load factor was low the maximum demand for energy might sometimes be a major consideration. The power of the main condenser circulated water pumps in a modern power station, for example, might exceed 100,000 h.p.; also the load imposed on an electricity supply network by dry dock pumps represented a very considerable proportion of the total load created by a harbour installation.

River Hayle Cable Crossing

A NEW 33 kV " feeder " from Hayle power station to Penzance which is nearing completion will help satisfy the increasing demand for electricity in Penzance and the Land's End peninsula. Altogether eight miles of overhead line have been erected, and the route selected will make it possible to provide a 33 kV supply to St. Ives when it becomes necessary in future. About 900 yards of underground cable have to be laid to complete the project.

The South Western Electricity Board's construction staff laid a submarine section of the new cable across the estuary of the River Hayle and the Cornwall Sub-Area engineers devised the means to suit local conditions. The 315 yards of cable, weighing about nine tons, was hauled across the estuary at low water, utilizing cable rollers along the section of the route above water level. By means of a power winch on a tractor, hauling operations began at 10.40 a.m. and were completed soon after noon. The bed of the estuary is of sand and at some places there are quicksands, but they were not troublesome at the point of crossing. As the bed of the estuary shifts from time to time according to tidal conditions and the amount of sluicing carried out, it was necessary to " snake " the cable in a section of the estuary to ensure that there will be sufficient slack cable to enable it to sink more deeply should the bed shift considerably. So that the cable should not lie on the bed (the estuary at point of crossing is navigable to steamers) it was buried, but trenches could not be dug in the section—which is never uncovered at low spring tides—due to the depth of water and the soft sand. The alternative idea of " blowing " a trench for the cable was successful, using high-pressure water jets and compressed air jets directed on to and into the sand along the route of the cable, which gradually sank, leaving no part exposed. The cable was manufactured by W. T. Glover & Co., Ltd., by whose courtesy the accompanying photograph is published.

Power cable crossing the River Hayle estuary in West Cornwall



Abridged I.E.E. Regulations

TO supplement the 12th edition of the Regulations for the Electrical Equipment of Buildings an abridged version of the rules dated 15th November, 1951, has now become available. It comprises only the requirements applicable to domestic single-phase a.c. installations, omitting all matters which are not the concern of those engaged in work on the site. The assumption is thus made that the proper planning and the ordering of materials have been attended to beforehand, so that materials which are delivered to the site shall be in accordance with the full I.E.E. Regulations.

Any points of interpretation which may arise in the application of the abridged rules must be resolved by reference to the full 12th edition which, being unchanged, retains its authoritative status.

The length of the abridged version approximates to one third of that of the full regulations. An index is provided and the numbering of the full regulations has been retained as far as possible, and in all instances in which the precise wording has been modified italics are used to indicate the change. For example, Regulation 111 which consists of 44 lines is reduced to three lines as follows:—

SV 111—Fuses shall be inserted in every non-earthed conductor. No fuse or non-linked switch shall be inserted in a conductor connected with earth.

For convenience as a pocket companion the format is 6⅞in by 4⅜in, bound in limp cloth only, copies being available for 2s 6d, post free, from the Institution of Electrical Engineers, Savoy Place, London, W.C.2.

Technical and Scientific Register

THE Technical and Scientific Register of the Ministry of Labour and National Service has moved from York House, Kingsway, to Almack House, 26–28, King Street, St. James's Square, London, S.W.1 (telephone: Trafalgar 7020). The nearest Underground stations are Piccadilly Circus and Green Park.

Commerce and Industry

Paris–London Television

Large Synchrotron for Glasgow

IT is announced by the B.B.C. that Mr. Cecil McGivern, controller of television programmes, and Mr. Imlay Watts were in Paris last week to study with the French Television Service the possibility of television relays between Paris and London, as a joint operation. This could probably be achieved by using the Paris–Lille radio link just established by Radiodiffusion et Television Francaise and on which regular services will begin very shortly. From Lille to Calais and from Calais to London micro-wave gear will be used and at some point on this part of the route a convertor will have to be employed to convert the French 819 line system to the B.B.C. 405 line system.

The two services agreed that if the project is realized they will aim at a week of programmes from Paris in 1952 ending probably on 14th July, the French National Day. The programme will be simultaneously transmitted from the French transmitters at Paris and Lille and from all British transmitters.

Electric Vehicle Booklet

The advantages of the battery-electric vehicle for certain specified classes of use, such as door to door delivery and collection work, are outlined in an 18-page illustrated brochure issued by the Electric Vehicle Association of Great Britain. It is profusely illustrated and shows examples of vehicles in use in various parts of the country by various trades. The silence, cleanliness, rapid acceleration, quick starting, economy, and general reliability of this type of vehicle are emphasized. The amount of electricity used on a day's round depends upon a number of factors, but the brochure states that an average figure for a 10–12 cwt vehicle is about $1\frac{3}{4}$ miles per kWh, and for a 20 cwt vehicle about $1\frac{1}{2}$ miles. In comparing costs, it is stated that taking everything into account, a 10 cwt payload electric vehicle doing 150 miles per week costs £4 6s 3d against £5 11s 2d for a petrol vehicle. The figures for a 1 ton vehicle doing 175 miles per week, are electric £5 10s 9d and petrol £7 1s 10d. Copies of the brochure can be obtained upon application to the secretary of the Association, at 2, Savoy Hill, London, W.C.2.

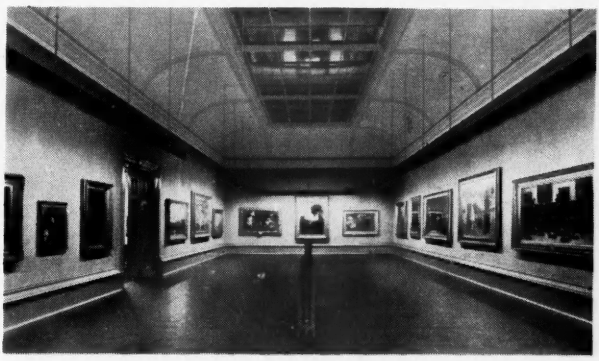
Engineers' Wage Offer

Following a demand for an increase of £1 a week in wages, the engineering employers have offered 11s a week to men in the industry and an additional week's holiday with pay. The offer was to be considered by the Council of the Confederation of Shipbuilding and Engineering Unions at York on Wednesday. At a meeting last Sunday the National Committee of the Amalgamated Engineering Union decided to recommend acceptance.

Art Gallery Lighting

The Walker Art Gallery, Liverpool, which houses many famous pictures, was taken over early in the war by the Ministry of Food, but was de-requisitioned some months ago. The task of restoring the building to its rightful use was put in hand at once, and it has recently been re-opened to the public. The rehabilitation of the Walker Art Gallery was under the direction of Dr. Ronald Bradbury, Liverpool city architect and director of housing, and the electrical installation was carried out by the City Lighting Department.

It was decided to incorporate an up-to-date lighting system using fluorescent lamps, and after a number of preliminary tests, fittings



General view of the G.E.C. fluorescent lighting in the Walker Art Gallery, Liverpool

specially designed by the General Electric Co., Ltd., were decided upon. These fittings, which are made of sheet steel, are equipped with a special reflector, designed to allow a proportion of the light to pass on to the upper walls, and so soften the cut-off shadow. After experiments with various colours, it was found that the "Osram" colour matching lamp gave the most satisfactory results. In order to minimize the number of suspension rods, the fittings were made in individual lengths of 5ft 6in to 6ft 0in overall, and arranged to butt end to end. In certain positions, mainly at end walls, where the 5ft 80 W lamp was too long, similar fittings, using 4ft or 3ft lamps are employed. In all cases the fittings are painted to match the colour of the walls, which varies from gallery to gallery. The whole installation comprises 206 fittings with 5ft fluorescent lamps, six with 4ft lamps, and 14 with 3ft lamps.

Commutator Makers' Coming-of-Age

The business of the Watliff Co. commenced in 1920 in a small way as a partnership in Battersea. It expanded rapidly during the next ten years, and in 1931 the partnership was converted into a limited company, the business being transferred to South Wimbledon. To mark its coming-of-age, the company has arranged a number of social events, while of particular interest to the trade is an exhibition at the works which has been in progress during the past fortnight. This exhibition, which has been arranged by the members of the staff, shows the various stages in commutator manufacture, from the raw materials to the finished product, and includes samples of the smallest, such as used in toy manufacture, to the larger commutators for industrial purposes. A number of the company's customers have lent appliances and equipment in which its commutators have been incorporated. The company does a considerable amount of export trade, its direct exports accounting for nearly 40 per cent of its output, while many of its commutators form part of equipment exported by its customers. Attention is drawn, by means of photographs and orders received, to some of the overseas destinations in forty-eight countries. Of historical interest are some of the early orders received which indicate the growth of the business.

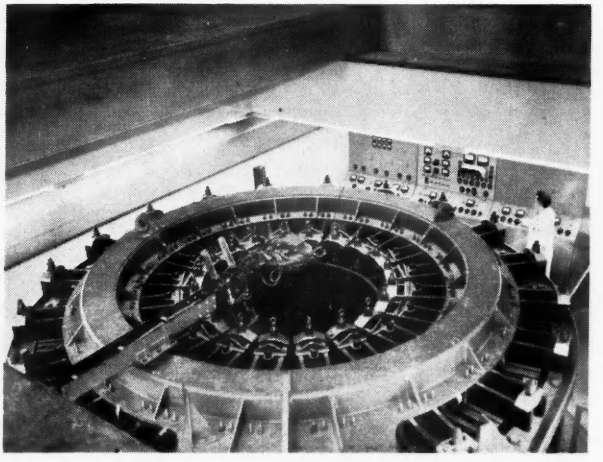
Philips Newcastle Showroom

The Lord Mayor of Newcastle-on-Tyne, Ald. W. McKeag, formally opened Philips Newcastle showroom on 13th November, before a gathering of leading business men and civic officials. In a short speech the Lord Mayor paid tribute to the pioneer work of Dr. Anton Philips in the electrical industry and complimented the company on its new attractive showroom. Mr. G. Hofman responded. After the opening ceremony, a luncheon was held at the Station Hotel, at which the Lord Mayor was the guest of honour. Among the head office executives who accompanied Mr. Hofman to Newcastle for the occasion, were Messrs. J. D. Barrington (sales promotion), S. G. P. de Lange (head of industrial group), N. D. Margerison (head of electrical appliances group), W. F. Oldham (head of Ela group), N. C. Pratt (publicity manager), and H. C. White (head of light group).

Glasgow Synchrotron

What is said to be the largest synchrotron of its type in Europe has been acquired by Glasgow University for research into atomic structure. It has been housed in a new building designed by Mr. Basil Spence.

The new synchrotron was tested at its full capacity of 300 million volts this month, Prof. Philip Dee told the Glasgow Royal Philosophical Society last week. The unit had been designed in co-operation with specialist firms in the field, each responsible for a phase of the unit and co-ordinated by the Atomic Research Establishment, Harwell. The



The Glasgow University synchrotron

Metropolitan-Vickers Electrical Co., Ltd., designed and built the 125 ton laminated alloy magnet which rests on a locomotive spring assembly to minimize vibration. This unit is situated in a radiation proof chamber with steel doors 1ft thick topped by a sliding slab which is part of the floor of the assembly hall above. Steatite & Porcelain Products, Ltd., made the vacuum chamber, which has been described as a particularly remarkable example of ceramic moulding work. The energizing unit was made by the British Thomson-Houston Co., Ltd.

Contract Price Adjustment Formulæ

The following are the latest figures for use in the B.E.A.M.A. contract price adjustment formulæ:—Rates of pay: the rate of pay for adult male labour at 10th November shall be deemed to be 120s. Costs of material: the index figure for intermediate products published by the Board of Trade on 10th November is 374·3 and is the figure for October.

"Washing at Home"

On 15th November Joan Robins, in the B.B.C.'s television programme, talked with electrical and gas experts on the merits of mechanical washing. One of the visitors was Mr. H. G. F. Gamble, of the Eastern Electricity Board, who is vice-chairman of the E.D.A. Domestic Appliances Committee. He had something pertinent to say about the speed and efficiency of electric washing machines. The latter were exemplified by one of the well-known makes.

Old "M.K." Catalogues

The M.K. Electric Co., Ltd., is asking for any copies of its old catalogues which may be in the possession of readers—and it offers a prize for the oldest sent in. Incidentally we are reminded in a letter that the initials in the company's title derive from its first patent (1919) covering the "Multy-Kontact" socket.

F.B.I. Register

The 1951–52 edition of the "F.B.I. Register of British Manufacturers," which has just been published, has been compiled by the publishers in close collaboration with the F.B.I. The information in its 882 pages is classified for quick reference in English, French and Spanish. The Register comprises seven sections and includes products and services, a classified buyers' guide listing over 6,000 F.B.I. member firms under more than 5,000 alphabetical trade headings; advertisements produced in colours, constituting an illustrated catalogue of British products; and an alphabetical directory of all F.B.I. member firms with their addresses, telegraphic addresses, telephone numbers, list of products, and in many cases their home and overseas branches, agencies, etc. All sections of the Register have reinforced guide tabs for easy reference. A foreword is contributed by the president, Sir Archibald Forbes. Among other information given it deals with the aims and activities of the F.B.I., dollar sales, overseas organization and services, F.B.I. overseas representation and services, trade associations, brands and trade names and trade marks. The Register, which is bound full cloth, is published for the F.B.I. by Kelly's Directories, Ltd., and Iliffe & Sons, Ltd., Dorset House, Stamford Street, London, S.E.1, at 42s post free.

Refrigerator Conference

A "Coldrator" distributors' conference was held in London on 24th October, at which Mr. R. G. Brandon, a director of the International Refrigerator Co., Ltd., presided. Distributors from all parts of the British Isles assembled for the meeting and were later entertained at the Savoy Hotel. Opening the conference, Mr. Brandon welcomed the distributors and proceeded to review the sales and manufacturing positions since the last meeting. Mr. H. R. V. Babbage, who has recently joined the company, was introduced, and Messrs. R. Warburton, J. Taylor and C. W. Barrett gave brief talks outlining the future activities of the departments. In the evening they were joined by Mr. O. H. Buckingham, director, deputizing for Mr. F. Spencer (managing director), Mr. K. J. R. Cocke, director, and Messrs. H. F. Adams and H. Brecknock.

Fuel Economy

The latest booklet, "Fuel Economy Pays," issued by the Federation of British Industries, shows how industry can avoid waste in the use of fuel and at the same time make substantial economies in costs. Advice given in the booklet is based on the experience of the Federation's Fuel Advisory Service. The booklet, which is divided into three main sections—common faults in boiler operation, the use of instruments for measurement and control, and the efficient use of heat—points to the main causes of waste in fuel and shows how such losses can be avoided. Many of the suggestions made can be carried out without large capital expenditure and with a saving not only in fuel but in cost which is often striking. Copies of the booklet can be obtained from the F.B.I. Technical Department, 21, Tothill Street, London, S.W.1, price 2s.

New Domestic Refrigerator

In the description of the new "Prestcold" 7 cu ft refrigerator on page 964 of our 9th November issue, the price was given as £131 3s 8d (plus P.T.). Actually this figure includes purchase tax.

A Mobile Office

The housing estates on the eastern fringe of London often separate the housewife from good shopping facilities and other amenities. To

alleviate the housewives' difficulties John Hudson & Co., Ltd., coal merchants, of Lloyds Avenue, London, E.C.3, are operating within a radius of nine miles from the company's depot at Dagenham Dock, a two-ton Tilling-Stevens battery-electric vehicle which spends two days a week parked on each of three estates—Debden, Harold Hill and Averley—functioning as a mobile office, taking orders, collecting cash, giving advice on fuel problems and so on. The vehicle was designed by members of the company's staff in conjunction with the builders, the Barking Garage & Engineering Co., Ltd. A two-way wireless installation links the vehicle with the company's Barking depot. Here the customers' records are kept and the radio telephone set, which is energized from the vehicle's 80 V " Exide-Ironclad " traction battery, is used daily for such matters as routine credit checks, etc.

Prices of Materials

In the accompanying table we give the prices of the more important materials used in the electrical industry. The figures are those quoted on Monday last.

ALUMINIUM Ingots	ton £124 0s 0d
COPPER, H.C. Electro	ton £227 0s 0d
Fire Refined 99·7 per cent ..	ton £226 0s 0d
Fire Refined 99·2 per cent ..	ton £225 10s 0d
COPPER Tubes	lb 2s 2d
Sheet	ton £277 10s 0d
H.C. wire and strip	ton £254 0s 0d
LEAD, English	ton £176 10s 0d
Foreign	ton £175 0s 0d
MERCURY	flask £73 10s 0d
TIN	ton £995 0s 0d
ZINC, G.O.B. Foreign	ton £190 0s 0d
Electrolytic	ton £194 0s 0d
BRASS Tubes	lb 2s 1d
Sheet	lb 2s 4½d
Wire	lb 2s 7½d
PHOSPHOR BRONZE	
Wire	lb 3s 6½d
RUBBER, No. 1 R.S.S. spot ..	lb 41d–41½d

Trade Announcements

Aluminium Wire & Cable Co., Ltd., announce the opening of a Midlands branch office at Great Western Buildings, 6, Livery Street, Birmingham, 3 (telephone : Cen. 5370).

The former offices of the **British Aluminium Co., Ltd.**, have now been de-requisitioned by the Government, and as from the 1st December next, the company's address will be Norfolk House, St. James's Square, London, S.W.1 (telephone : Whitehall 7868).

Refrigeration (Western), Ltd., whose head office is at Shrewsbury, have extended their territory to include the area previously covered by MacWhirter, Ltd., of Cardiff, and are now solely responsible for all " Prestcold " refrigeration sales and service within this additional area, operating from 79, Tudor Road, Cardiff (telephone : 3742) and 12, Prince of Wales Road, Swansea (telephone 55017).

The Sulphur Position

The Sulphur Committee of the International Materials Conference has published figures showing that in 1951 world requirements of sulphur, both crude and refined, amount to approximately 7,134,200 long tons, whereas it is expected that production will amount to 5,862,300 tons, leaving a shortage of 1,271,900 tons ; and that in 1952 the requirements are estimated at 7,596,300 tons while the production foreseen is 6,255,600 tons, leaving a shortage of 1,340,700 tons. The Committee is making every effort to encourage governments to increase their production, not only of sulphur, but of all sulphur bearing materials. All countries are urged to make the most economical use of the amounts of sulphur available to them.

Contractors and the Industry

At the annual dinner of the Southern Section of the Electrical Contractors' Association at Southampton, Mr. Stanley Watkins, president of the E.C.A., said that the contractor felt that the present trading structure of the industry was not satisfactory to him. Not only did his fellow contractors compete with him for business but manufacturers as well. The sooner they realized what contractors had done for the industry and co-operated in putting things on a proper footing, the better would the Association be pleased.

Mr. C. Hughes, chairman of the Electric Lamp Manufacturers' Association, spoke of the E.C.A.'s recent golden jubilee and said that to-day the Association had a membership of something like 3,000, all pledged to do a good job of work and safeguard the user of electrical equipment. The younger generation, perhaps, did not realize that it was the invention and development of the electric lamp which really built the electrical industry. Mr. Hughes mentioned the report of the Monopolies Commission which, he said, he had not read at the time he was speaking. The industry he represented as chairman of E.L.M.A. had for some time been under investigation but they were not ashamed of the work they had done over many years.

Mr. H. Taplin, chairman of the Southern Section, E.C.A., presided at the dinner.

An Unusual Change-over

In connection with the review of its activities in the *Electrical Review* of 9th November, Chilton Electric Products, Ltd., points out that its parent company, the Chilton Aircraft Co., Ltd., is still in existence and carries out extensive contracts for parts for the aircraft industry, etc.

Power Station Boilers

Review of British Practice

IN a lecture to the Electrical Power Engineers' Association (London Technical Group) on 12th November, Mr. W. F. Simonson reviewed trends in water-tube boiler designs as reflected in the E.E.A. programme at 31st March last. Defining the functions of a boiler as, first, the most efficient conversion of the heat energy of coal into that of steam and, secondly, the separation and rejection of its incombustible constituents, he said that more than half the 33 million tons of coal burned last year was untreated and contained up to 25 per cent ash.

Steam Conditions

Since 1938 the average calorific value of 11,550 B.Th.U./lb had declined to 10,950 B.Th.U./lb, but the delivered price of 227·5d/ton had increased to 608·7d/ton. Over 92 per cent of the total capacity of 117 million lb/hr of the 368 boilers in the programme was provided by units designed for the standard steam conditions of 600 lb/sq in and 850 deg F, 900 lb/sq in and 900 deg F, or 1,500 lb/sq in and 1,050 deg F. Nearly one-quarter was provided by 51 boilers of 500,000 to 550,000 lb each, eleven of which were for 600 MW " unit " boiler-turbine combinations. The unit principle was also applied to four of the sixteen boilers at 1,500 lb/sq in ; these were rated at 830,000 lb/hr and would be associated with 100 MW turbines ; a fifth, of 755,000 lb/hr, was for supplying a 100 MW reheat installation. Boilers of under 200 lb/hr were almost all for extensions to existing stations.

The maximum output of a travelling grate stoker was limited to 260,000 lb/hr by the largest feasible total area of twin grates, viz. 600 to 700 sq ft, so at least two-thirds of the boilers (supplying over three-quarters of the steam) would be fired with pulverized fuel which also gave comparative immunity from harmful deposits on exterior surfaces. Two notable recent developments were the spreader stoker (over-feed firing) for medium capacity units, which was claimed to embody the flexibility of p.f. firing, and the cyclone furnace.

The latter, like the slag-tap furnace, represented a departure from the usual British practice of discharging ash in a dry state, in view of the wide variety of fuel supplied and the need to provide for intermittent shift operation. Varying nature of the fuel with differing ash content and fusion characteristics was also responsible for the general adoption of convection superheaters, normally of the multi-loop type. Control of temperature was usually by a surface or spray attemperator between primary and secondary sections—a method which called for a high degree of steam purity.

Steaming economizers, which delivered feed water at a temperature and density approaching those in the drum, maintained the steady water level necessary to secure steam purity to the turbine at high boiler ratings. High steam pressures, as such, caused little difficulty in boiler design, owing largely to developments in welding technique, but the associated high steam and feed temperatures raised problems in furnace and superheater design and in the disposition of heat recovery surfaces of economizers and air-heaters so as to secure high thermal efficiencies. To ensure a large proportion of heat recovery in the air heater, pulverized fuel firing was practically essential, irrespective of boiler capacity.

Temperature Requirements

High temperatures at superheater outlets had to be held within narrow limits over a wide range of boiler output (e.g., 60 to 100 per cent). A safe gas temperature at the furnace exit must be maintained. because of softening and fusion temperatures of the ash. On the other hand an adequate temperature gradient between gases and steam was requisite to economy in superheater surface. As gas exit temperatures that furnished a suitable volumetric heat release increased with boiler size, the cubical configuration of large furnaces

tended to give place to a vertically elongated type, which gave greater ratio of surface to volume, so correcting the gas leaving figure. The proportion of heat transfer by radiation was thus increased and, with diminishing latent heat of evaporation with rise in steam pressure, the boiler tended to become a radiant-transfer water-cooled furnace, the combustion chamber riser tubes providing the small amount of convection surface necessary.

A number of slides were shown which illustrated the various features described, including those mentioned in the following notes.

A John Thompson stoker-fired forced-circulation boiler (Woolwich) rated at 180,000 lb/hr is designed to secure high availability with two-shaft working. An International Combustion spreader stoker of 200,000 lb/hr (Rotherham power station) includes provision for collecting grits at those points in the gas circuit for re-firing over the rear arch and a multi-cell dust collector at fan-floor level. In a similar type by Babcock & Wilcox (Kearsley) each feeder was shown to be associated with a separate section of the forward-moving grate.

A compact unit for 160,000 lb/hr or so is provided by the " integral furnace " of Babcock & Wilcox, which has been adopted for six 160,000 lb/hr boilers in a two-shift station; in these the boiler heating surface is arranged at the side of the furnace. The " sky-scraper " furnace by International Combustion for a 400,000 lb/hr boiler (Stuart Street) is another modern design with completely water-cooled combustion chamber of fin-tube construction. For unit operation with a 60 MW turbo-alternator (Tilbury) a John Thompson 540,000 lb/hr boiler is characterized by separate groups of external downcomers, each group serving a specific system of riser tubes and constituting, in effect, an independent circulating system.

A Simon-Carves 360,000 lb/hr unit (Chadderton) is of radiant design with a small amount of convection surface provided by the front wall riser tubes of the combustion chamber which also form the roof tubes; all riser tubes enter the front drum above water level. A twin-furnace Stirling design offers an alternative to the " sky-scraper " for maintaining the correct ratio between furnace volume and surface area in a large boiler (550,000 lb/sq in, at Keadby), the additional radiant heat absorbing surface being provided by central vertical water screen. The Stirlin slag-tap furnace, 525,000 lb/hr (Stourport was described in the *Electrical Review* o 29th September, 1950.

A cyclone furnace by Babcock & Wilcox for a 540,000 lb/sq in boiler (Barking " C ") will use coal crushed to 0·2in the ash from which becomes fluid, thereby eliminating fly-ash and carbon losses. Details were given of a modern design of superheater (for Drakelow) by the Superheater Co.; this is to be installed in a 515,000 lb/hr boiler with steam conditions of 6,500 lb/sq in and 1,050 deg F. The combustion chamber gas outlet is throated and the secondary superheater is disposed with no intervening boiler tubes; it is therefore practically a radiant transfer unit with widely pitched stainless steel tubing; the pendant section is entirely gas swept. The horizontal multi-loop primary superheater has steam cooled supports of small-bore inlet tubes evenly distributed along the rear drum and led vertically downwards to the bottom saturated steam feeder, which forms the drainage point.

Railway Traction Experiments

BRITISH Railways have decided to carry out a trial of the single-phase 50 c/s system of electric traction. The experiment will be on the Lancaster–Morecambe–Heysham line, which was originally electrified experimentally in 1908 at 6·6 kV and 25 c/s, the equipment being now life-expired. By arrangement with the principal electrical manufacturers various methods and types of equipment are be tried out, for which purpose the overhead line voltage will be varied from the present 6·6 kV up to and including 20 kV.

This traction system, says the Railway Executive, in which power is fed directly to the trains at high voltage and at the standard national frequency, was recommended by the recent B.T.C. Report on Electrification for consideration for secondary lines, the recommended system for lines carrying heavier traffic being 1,500 V d.c. collected from overhead conductors. It introduces special problems, but also several advantages, including the use of a lighter overhead system, fewer and simpler substations and the absence of power cables alongside the track. As a result of recent advances in technical development it may now have a wider field of economic application. This experimental electrification will provide experience of the suitability of standard frequency a.c. electrification for conditions in this country.

Engineering in Europe

Survey of Current Literature

A FURTHER contribution of these well-known authors to their special field of research presents a new theory of the surge phenomena in a single layer coil which permits the determination of voltage distribution and gradient in the coil. It is based on a series expansion in terms involving the "space" and time frequency (which are linked by a quadratic relation), and the coefficients determining the space distribution are hyperbolic functions. These may, however, be neglected for a coil with one end earthed, or, if the end is isolated, at least for the higher harmonics. It is thus found that the propagation of the longitudinal voltage gradient along the coil has wave character, which agrees with experimental results of Frid, Norris and the authors themselves.

In a former communication of the authors the principle was established that "by assuming in a first approximation that all h.f. waves are propagated at the same speed, it becomes possible to represent the maximum stresses between individual turns in the form of a travelling wave, because these stresses are mainly due to h.f. waves." This principle may also be applied to surge phenomena and yields the result that the stress in the coil after the passage of a surge depends only on the initial voltage distribution; in other words, on the distribution of the coil capacitances. The examples calculated refer to coils with earthed and with free ends.—"Electric Stresses in a Coil under a Unit Surge," B. Heller and A. Veverka, *Elektrotechnicky Obzor*, Vol. 40, pp. 143–151, No. 7–10, 21st May, 1951, in Czech.

Rectifier Effects on Power Plant

The necessity of considering the influence of large power rectifiers on the operation of alternators and transformers may be illustrated by referring to actual cases in which the entire power of a three-phase system is used only for supplying a rectifier station for electrolysis, consuming up to 100 MW. The paper investigates an "infinitely large" rectifier working in a three-phase system whose capacitance is neglected. The rectifier is supposed to have a star-connected primary and to duplicate the phases on the secondary side. The wave-form of the anode current is square (for each of the two groups) with a phase difference of 180 deg.

The results show an increase of the losses in the winding of transformers and alternator armatures owing to the higher current harmonics. It is, however, possible to reduce these losses very considerably by an appropriate design of the windings. The effect of the higher harmonics of the stator current on the rotor and on the loading of the damper winding is also analysed. Limits of rectifier loading considering the loading of the damper winding are found with the number of rectifier phases and the angle of overlap of the massive rotor as parameters (turbo-generator).—"Effect of Rectifiers on the Operation of Alternators and Transformers," B. Heller, *Elektrotechnicky Obzor*, Vol. 40, pp. 173–179, No. 7–10, 21st May, 1951, in Czech.

Power System Modelling

Many problems of modern power system design and operation cannot be solved, if at all, with anything like the required accuracy by conventional calculation methods, but network analysers and dynamical models make most of these investigations not only possible, but even comparatively easy. It is true that they set some problems of their own, but the latter may be solved once for all because they are of a general rather than of a special character. The most intricate are alternator models, which may be either standard alternators on an appropriately reduced scale, or "models" designed for the purpose, together with their exciters.

The crux of the problem is obviously that the parameters of the life-size machine

Readers may arrange, by request, to obtain accurate full translations of any of the articles abstracted in this section at the usual rates.—Editors, *Electrical Review*.

cannot all be reduced simply to scale, if a correct representation of the whole system is to result. It is, for instance, well known and obvious that armature resistances of small machines cannot be obtained as small as those of the actual machines. Then there is the even more complex aspect of transient and sub-transient reactances, the time-constants, etc., yet the paper shows that by compromises and inventiveness applied to every detail the design of satisfactory models is possible. In particular, a series compensator and a d.c. convertor are described in full detail, showing the method of model-design to a given strict specification.—" Synchronous Generator for Dynamic Modelling of Power Systems," V. A. Venikov and A. V. Ivanov-Smolenskii, *Elektrichestvo*, No. 8, pp. 19–26, August, 1951, in Russian.

Thermal Motor Protection

The motors considered are single-phase and have class " A " insulation. There are two types of protection: those only sensitive to temperature (thermo-elements and resistance coils) which have long been used for large machines and others sensitive to the current passed through them and to the temperature of the medium in which they are placed. There are various difficulties in selection of the most appropriate and notable differences in the choice according to whether the motors to be protected are, or are not, mass-produced, open or closed types, etc. Also, a careful examination and check of many curves, sometimes issued by professional bodies, referring to temperature effects on insulation, effective coil temperatures of protected motors, etc., shows that in many cases they are by no means correct, or accurate enough to base the design of protection on them.

Internal thermal protection is mostly by Spencer disc (bimetal) and some series of standardized devices covering a wide range of variations of the current-temperature relation have been produced. The current-temperature characteristics for the chosen limiting temperatures are, however, not independent of the ambient temperature of the protective device. The latter is difficult to determine as the protective element must be mounted internally near the hot spot of the motor and will be different in the important case of " locked rotor " (on starting). However, the author succeeds in demonstrating that, and in which way, the protection can be standardized.—" A Method of Selecting Protective Devices against Dangerous Overheating of Low-Powered Motors," V. G. Vaughan, *Revue Générale de l'Électricité*, Vol. 60, pp. 265–273, No. 7, July, 1951, in French.

Selective Cable Protection

Examination of the suitability of the various types of " parallel protection " for cable systems in relation to their special requirements, such as auxiliary wires, special relays and instrument transformers, indicates a comparatively simple way of calculating the distribution of the short-circuit currents in a system of parallel cables fed at one end; the resulting formulæ are shown to be special cases of those for systems fed at both ends. The calculations are based on simplifying assumptions, but they yield results useful in themselves and also indicate the principle to be followed in the calculation of systems fed bilaterally. The results of the calculation of the more general case enable a set of conditions, to be satisfied by the relay protection, to be drawn up.

Comparison of these with the conventional types of relays shows that over-current relays of the usual type can be only of limited use in the protection of parallel cable systems; directional relays are suitable only for unilaterally fed systems; (longitudinal) differential relays are the safest, though most expensive, protection for parallel systems, but the transverse differential relay type, though making the protective system a little more complicated, is the author's preferred solution, of which he gives an example (group of transverse differential relays with rectifiers and polarized relays). Lastly, a new relay of the author's own design is described. — " Short-circuits in Parallel Cable Lines: Current Distribution and Selective Protection," G. Schulerud, *Elektroteknisk Tidskrift*, Vol. 64, pp. 285–295, No. 23, 15th August, 1951, in Norwegian.

National Packaging Exhibition

It is announced by the Institute of Packaging and the organizers (Provincial Exhibitions, Ltd.) that the third National Packing Exhibition is to be held at Olympia, London, from 20th to 30th January, 1953.

RECENT INTRODUCTIONS

NOTES ON NEW ELECTRICAL AND ALLIED PRODUCTS

Water-tight Coupler

A THREE-PIN 5 A water-tight rubber coupler is now available from NETTLE ACCESSORIES, LTD., Harper Road, Wythenshawe, Manchester. It has a heavy porcelain interior to withstand rough usage and both the socket and plug interiors are easily removable for wiring. The cable entries will accept up to three-core, heavy duty 70/.0076 cables and the pin centres are to B.S. 546. The rubber flange shown in the illustration seals and locks together the socket and plug portions of the coupler while the clip provided at each cable entry allows the rubber sleeves to be clamped tightly to the cable. An acid-proof coupler is also available.

Dry Shaver

The "Favorit" Swiss dry shaver introduced on the British market by LIDA (LONDON), LTD., Warnford Court, Throgmorton Street, London, E.C.2, is simple in construction and exceptionally small and quiet. The apparatus operates on the magnetic coil principle and the turning of a tuning screw adjusts the vibration to ensure quiet running. The "direct-cut" blade, which is quite safe, gives a really close shave, and although self-sharpening, can be replaced at a small cost. The price is 56s 2d (plus 13s 4d P.T.).

Edison-screw Lampholders

Fitting a screw type lamp into a porcelain holder has always been an awkward job. More often than not the lamp is rubbed against the porcelain, which scores the envelope, and sooner or later the weakened glass snaps off. The SIMPLEX ELECTRIC CO., LTD., Broadwell, Oldbury, Birmingham, now coats the rims of its lampholders with a metal spray. These "No-Score" lampholders are available in skirted e.s. or g.e.s. types.

Mobile Fluorescent Fitting

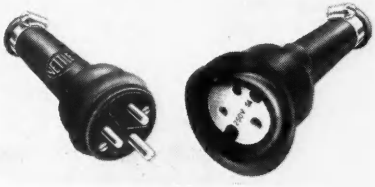
A fluorescent lighting fitting mounted on four castors has been brought out by SCEMCO, LTD., Soho Street, London, W.1, for use in garages, etc. It comprises a 24 in 20 W fluorescent tube sealed in "Perspex," which is in turn protected by a strong wire cage, and its main advantages are that it produces no shadow, glare or heat. The trade price is 5 gns with 2s 9d purchase tax on the tube only.

Large-capacity Refrigerator

The R66.51 refrigerator made by H.M.V. HOUSEHOLD APPLIANCES, Hayes, Middlesex, combines recent technical developments with an attractive streamlined appearance. The 6·5 cu ft of space is carefully arranged with 11½ sq ft of shelf area, 17 lb of frozen storage capacity and ice trays giving 3½ lb of cubes. There are also a large meat keeper and a crisper. A sealed noiseless type of operating unit is incorporated. Until further notice these refrigerators will be available only within 60 miles of London. The price is £119 6s 2d (plus £58 2s 10d P.T.).

H.M.V. refrigerator type R66.51

"Nettle" water-tight rubber coupler



New Materials

Their Significance in Engineering

THE Friday evening discourse last week at the Royal Institution in London was delivered by Dr. T. E. Allibone (Associated Electrical Industries, Ltd.), who commenced with the observation that one of the most remarkable developments of the last decade had been the growth of the industry based on synthetic polymers. The electrical engineer had made great use of polythene on account of its low dielectric loss: it had revolutionized communication engineering, as signals of all frequencies were attenuated only slightly in polythene cables compared with cables containing cellulose. The synthetic rubbers were more resistant to chemical attack and the silicon polymers more resistant to heat. Co-polymerization of synthetic resins *in situ* eliminated voids from insulation and impenetrable coatings of synthetic polymers prevented the ingress of moisture into insulation. Synthetic adhesives having good insulating and strong mechanical properties were being used experimentally to fasten porcelain to metal and, mixed with zircon, provided strong insulation of high electric strength.

Barium titanate and a family of related substances had dielectric constants many times greater than mica, due to a small misfit of a crystalline lattice. They could be used to make very compact condensers and the same physical feature of the lattice was responsible for their strong piezo-electric properties.

Semi-conducting elements, such as silicon, produced in pure form, or containing controlled traces of impurities, had resulted in a complete reassessment of the importance of semi-conductors. Silicon and germanium rectifiers, and germanium three-electrode " valves " were likely to replace thermionic valves in many circuits and supplement them in many others. They might only be the beginning of a vast development based on a better understanding of the electronic conduction process in materials which were almost insulators. Thus the mixture of two metal oxides, each a good insulator, could have quite a low resistance due to the movement of valency electrons from one to another metal ion. New developments of photo-conducting crystals provided detectors of X-rays and infra-red rays.

Magnetic materials were now profiting from the extensive basic research of the last twenty years, the cost of which might be fully repaid by reduction of hysteresis loss in electrical machines. The very sudden transition from a state of being magnetized to one of magnetic saturation of modern post-war iron alloys opened up a wide new field of application of iron cores as " switches " without moving contacts.

The electrical engineer was dependent on new developments in metallurgy. He wanted higher temperatures for turbines, greater resistance to corrosion of metals, metals which did not absorb neutrons but had the right mechanical properties for use in " boilers," and metals of good cutting properties, low friction and small wear for use in bearings. Sintering of metal and non-metallic powders in the electric induction furnace had provided the hardest metals, porous metals which carried a lubricant for a bearing, and metal and oxide mixtures which might be better than metallic alloys for turbine blades. The electric arc furnace, described over a hundred years ago, was at last coming into its own for melting metal like titanium and zirconium in argon gas to avoid oxidation.

Fuel Research

THE Report of the Fuel Research Board for 1946–49 deals largely with the transition from short term wartime researches to postwar repair and re-equipment of the Fuel Research Station. Apart from the design of burners for firing pulverized coal to steam boilers the Station is now engaged on the design and development of combustion chambers to enable coal to be used in gas turbines. The Station is also engaged in investigations sponsored by the Boiler Availability Committee into the cause and effects of deposits of solid matter on the external heating surfaces of power station boilers. The investigations include full scale experiments in power stations with the object of reducing periods of shutdown needed for cleaning boilers. The Report is obtainable from the Stationery Office, price 3s 2d, post free.

ELECTRICITY SUPPLY

Generation in October

North Somerset Bulk Supply Point

FIGURES published by the Ministry of Fuel and Power show that at the end of last month the installed plant capacity at generating stations controlled by the British Electricity Authority, the North of Scotland Hydro-Electric Board and the Lochaber Power Co. was 15,607 MW. At the end of 1950 the capacity was 15,085 MW, so that in the ten months of the year only 522 MW has been added. New plant installed at B.E.A. stations last month was confined to boilers—two of 300,000 lb/hr at Braehead and one of 365,000 lb/hr at Cliff Quay, all of Babcock & Wilcox manufacture.

During October 5,289 million kWh was generated compared with 4,825 million in the corresponding month last year, an increase of 9·6 per cent—the highest since June. Water power output was again at a reduced level, being nearly 40 per cent less than in October, 1950.

Malvern Hills Line

In the Chancery Division on 13th November Mr. Justice Harman heard a motion for an interim injunction on behalf of the National Trust to restrain the Midlands Electricity Board from proceeding with an overhead line in the Malvern Hills. His Lordship, by consent, ordered a speedy trial of the action.

Council for the Trust said that his clients held certain restrictive covenants to protect the amenities of the Malvern Hills. The Board had obtained consent to erect a 66 kV overhead power line across part of the land subject to covenants; this would be supported on poles about 20ft high. After a public inquiry the Minister of Fuel and Power had consented to the project, subject to the laying of part of the line underground. The Trust recognized the urgency of providing an additional electricity supply and it was not therefore insisting that the line should be wholly underground. There were three poles, however, which would have a detrimental effect upon the amenities and application was only in respect of this part of the line.

The Board's case was that the reinforcement of the supply to Herefordshire was a matter of extreme urgency. The number of consumers to be served had considerably increased and a breakdown would deprive between 15,000 and 20,000 people of their supply.

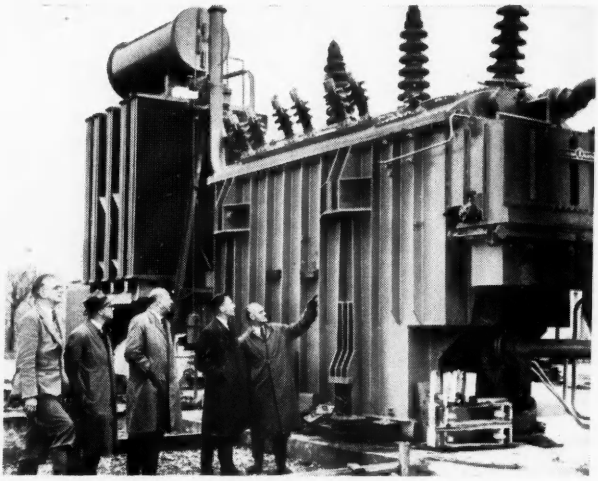
It was agreed that as it would not be possible to complete the line and its connections in the immediate future an order should be made for a speedy trial. The Board agreed not to proceed with the work in the meantime.

North Somerset Reinforcement

Plans to reinforce the network in North Somerset at a cost of nearly £300,000 were referred to in the 1950–51 annual report of the South Western Electricity Board. The schemes include the construction of a 132 kV bulk supply point at Churchill, a 33 kV line from Portishead to Congresbury via Clevedon and a 33 kV line from Churchill to Midsomer Norton. The change-over to the new grid supply point at Churchill (initial capacity 60,000 kW) began on 14th November and took several days to

	Fuel consumed Thousand tons		kWh generated Millions			kWh sent out Millions	Installed capacity (m.c.r.) MW
	Coal	Oil	Steam	Water power	Total*		
British Electricity Authority ..	2,999	4·9	5,136	19	5,164	4,864	14,992
North of Scotland	26	1·1	37	84	125	122	615
Total for October, 1951	3,025	6·0	5,173	103	5,289	4,986	15,607
Total for October, 1950	2,762	6·5	4,639	170	4,825	4,560	14,645
Increase or decrease, per cent ..	+9·5	−7·7	+11·5	−39·4	+9·6	+9·3	+6·6
Total for year to date (10 months)	27,917	70·8	47,392	1,132	48,667	45,911	
Total for corresponding 10 months of 1950	25,146	53·7	42,370	1,188	43,693	41,239	
Increase or decrease, per cent ..	+11·0	+31·8	+11·9	−4·7	+11·4	+11·3	

* The total includes 9 million kWh generated by oil engines and 4·2 million kWh by waste heat plants in October.



Mr. S. F. Steward, chairman of the South Western Electricity Board, with Mr. G. O. McLean, the chief engineer, and other officers of the Board and Division inspecting the transformer at the new Churchill substation

complete. It necessitated the disconnection of the section of the grid line from Portishead to Bridgwater (part of the 132 kV line from the North) so that temporarily North Somerset, Taunton and North Devon were dependent on power stations in the area and the grid line from Poole power station via Exeter.

Another B.E.A. Collier Launched

On 14th November, Miss Josephine Clarke, god-daughter of Mr. Norman Elliott, chairman of the South Eastern Electricity Board, launched the 2,700 ton collier *Hackney* built by S. P. Austin & Son, Ltd., Sunderland. This is the last of three vessels built by the company for the B.E.A.; the first, *Brunswick Wharf*, is now in service, and the second, *Deptford*, is being fitted out and may be ready for handing over by the end of this month.

Breakdown in N. Scotland

An electricity breakdown cut off supplies to places in eight Scottish north and north-east counties for a short time on 12th November. The affected areas ranged from southern Kincardine to Helmsdale, Sutherland, and the interruption lasted for periods up to half an hour from shortly after 11 a.m. The breakdown was stated to be due to a fault on the 132 kV main transmission line between Tummel Bridge and Beauly, and trouble in the generating plant at Fasnakyle was also reported.

Boiler Explosion

An explosion of a water tube boiler which killed one man and injured two others occurred in the generating station at Guildford, Surrey (South Eastern Division, B.E.A.), on 7th May last. The boiler concerned was of the Stirling three drum type with an integral economizer, about 24 years old, and had been regularly inspected. The extreme left-hand tube in the second row of the front bank ruptured at approximately the middle of its length and opened out, allowing the contents of the boiler to escape into the furnace. The steam pressure at the time of the explosion was about 265 lb/sq in. A report (No. 3357) on a preliminary inquiry into the mishap issued from the Marine Surveyors' Office, Ministry of Transport, states that the explosion was caused by local overheating due to deposits of hard scale within the tube, which had swelled. It would appear that the hard scale found in the tubes was formed prior to the adoption of feed water treatment.

New Power Station

The first of the four 50 MW generators at the new Bromborough power station, Cheshire, was put into operation last week. It is expected that the second generator, which is now almost completed, will be on load by the end of the month. The B.E.A. anticipates that the station will be in full production by this time next year.

Higher Charges in Ulster

The *Belfast Telegraph* reports that the Electricity Board for Northern Ireland is increasing its charges as from the first accounting period in the New Year. The lighting flat rate will be raised from 8d to 9¼d/kWh. Where less than 100 kWh a quarter is used for heating and cooking the charge will go up from 1·5d to 2·1d/kWh and for greater consumption, from 1d to 1·6d. The two-part tariff fixed charge is to be raised from £1 11s 3d to £1 14s 4d for houses under 500 sq ft and from £3 2s 6d to £3 8s 8d up to 1,000 sq ft. The running charge will be increased from 0·75d to 1·3d/kWh for the first 500 kWh and from 0·5d to 1d/kWh thereafter. For shop window lighting the new rate will be 2¾d (against 2d). The existing coal clause charge is to be incorporated in the basic tariff, and a new clause introduced based on the present average price of 65s/ton.

FINANCIAL SECTION

Company Notes and Stock Exchange Activities

Reports and Dividends

Burco, Ltd.—In his statement accompanying the report and accounts for 1950-51, Mr. D. K. Ward (chairman and managing director) says that the "Burco" all-electric washer has made its debut. This has been well received and they have exported 75 per cent of their total production. The directors have considered the capitalization of reserves in the form of a bonus issue to bring the issued capital more in line with what is used in the business. The present uncertainties must be clarified before they can proceed in this matter.

S. Smith & Sons (England), Ltd., report consolidated profits for the year to 4th August last of £1,520,031 as compared with £1,101,580 for the preceding year, and after deducting £918,368 for taxation, the net profit is £601,663 (against £420,180), to which is added £92,746, items relating to previous year, making £694,409. The net profit attributable to the parent company is £452,236 (£325,012) It is proposed to pay a final ordinary dividend of 10 per cent, making 12½ per cent for the year. In December last year the capital structure was altered and increased, the preferred ordinary and deferred ordinary being consolidated into ordinary. A sum of £1,362,402 was capitalized. For the previous 53 weeks the holders of the preferred ordinary received 17½ per cent and of the deferred ordinary 37½ per cent.

Joseph Lucas, Ltd., report a consolidated surplus for the year to 31st July last, after deducting taxation of £3,802,780, of £1,609,032, as compared with £1,359,474 for the preceding year. After crediting other income £221,041, and deducting profits retained by the subsidiaries £901,776, the net profit of Joseph Lucas is £928,297 (against £828,362). It is proposed to pay a final ordinary dividend of 5 5/6 per cent (against 5 per cent), making 7½ per cent for the year (against 6⅔ per cent).

Morphy-Richards, Ltd., propose to issue more capital to equip and work the new factory, for which £75,000 is needed; and also to repay the £75,000 of 5 per cent unsecured notes. Treasury consent has been obtained. The notes were issued privately in December, 1948, at par and have until 1955 to run. The directors think it desirable, however, to replace them by permanent capital, and their repayment on 31st March next at 104 is proposed.

The new issues of capital consist of 130,000 6 per cent £1 redeemable preference and 55,000 4s ordinary, the latter at a premium to be settled. The issued capital would then consist of the new preference and £121,000 of ordinary. The new shares are to be offered to existing shareholders.

Richard Johnson & Nephew, Ltd., are paying an interim dividend of 4 per cent (against 5 per cent). The company proposes to capitalize £900,000 of reserves to be distributed in the form of ordinary shares to existing members in proportion of one for every share now held.

The Telephone Manufacturing Co., Ltd., has declared an interim dividend of 2½ per cent (unchanged).

Ward & Goldstone, Ltd., are paying an unchanged interim dividend of 20 per cent, but on larger capital.

Johnson & Phillips, Ltd., have announced an interim dividend of 7½ per cent (unchanged).

Enfield Cables, Ltd., are again paying an interim dividend of 3¾ per cent.

Vent-Axia, Ltd., have declared an unchanged interim dividend of 25 per cent.

New Companies

Moor End Engineering Co., Ltd.—Registered 6th November. Capital £2,000. Manufacturers, importers, exporters and hirers of and dealers in electric power and transmission plant and equipment, etc. Directors: B. S. Cook, 61, New Laithes Hill, Huddersfield, and F. Morton, 692, Bradford Road, Huddersfield.

F. H. Christian (Radio), Ltd.—Registered 7th November. Capital £1,500. Manufacturers of and dealers in electrical goods of all kinds, wireless and television sets, etc. Directors: F. H. Christian and Mrs. E. E. Christian. Regd. office: 21, Station Road, Harrow, Middx.

Unique Radio Services, Ltd.—Registered 7th November. Capital £1,000. Manufacturers and repairers of and dealers in wireless sets, gramophones, radio gramophones, television sets, etc. Directors: H. C. Verier and J. W. Hall. Regd. office: 7, Station Approach, College Road, Harrow, Middx.

Canbridge Engineering Co. (London), Ltd.—Registered 14th November. Capital £1,500. Manufacturers of heavy and light

duty switches, switch gear, etc. Directors : J. W. Raine, A. L. Duff and J. Roberts. Regd. office : Rodsley Street, Old Kent Road, S.E.1.

O'Connell Bros. (Cork), Ltd.—Registered in Dublin 30th October. Capital £10,000. General, electrical and radio engineers, battery importers, assemblers and dealers, etc. Directors : W. E. O'Connell, Mansfield Cottage, Passage West, Cork; M. D. O'Connell, 9, Strand Street, Passage West, Cork; G. O'Connell and G. A. O'Connell.

Wynall Transformers, Ltd.—Registered 3rd November. Capital £1,000. Electrical and motor engineers, etc. Directors : A. C. Withnell, 2, Friars Lane, Richmond, Surrey and J. A. Hall, " Sunnyfielde," Haven Road, Canford Cliffs, Bournemouth.

Walter Logan & Co., Ltd.—Registered 9th November. Capital £500. Importers and exporters of and dealers in electrical appliances, wireless and television sets and components, etc. Directors : W. Logan, Winifred A. Logan and D. Josephs. Regd. office : 1, Kenton Street, W.C.1.

Palmers of Middlesbrough, Ltd.—Registered 10th November. Capital £2,500. Manufacturers, importers, exporters and servicers of and dealers in all kinds of wireless and television apparatus, cabinets, loudspeakers, receiving and transmitting sets, etc. Directors : J. G. Palmer and Hilary W. Szymanowski. Regd. office : 106, Newport Road, Middlesbrough.

L. A. Glazier, Ltd.—Registered 9th November. Capital £1,000. Manufacturers and repairers of and dealers in lighting and power equipment, generators, dynamos, etc. Directors : L. A. Glazier and Mrs. Violet M. Glazier. Regd. office : Commerce House, 6/8, Blagrave Street, Reading.

Increases of Capital

James Scott & Co. (Electrical Engineers), Ltd.—Increased by £100,000, in 2s ordinary shares, beyond the registered capital of £100,000.

Standard Telephones & Cables, Ltd.—Increased by £2,500,000, in £1 ordinary shares, beyond the registered capital of £2,500,000. To 12th October 1951, International Standard Electrical Corporation of New York, U.S.A., held practically all the issued shares.

A. Reyrolle & Co., Ltd.—Increased by £1,000,000, in £1 ordinary shares, beyond the registered capital of £2,000,000.

Liquidations

C.M.C. (Switchmatic), Ltd.—Winding up voluntarily. Liquidator, Mr. J. S. Bradley-Hole, of A. E. Orbell & Co., 7, Old Steine, Brighton.

W. D. Willson (Sussex), Ltd.—Winding up voluntarily. Liquidator, Mr. J. T. Morgan, 100, Park Street, Grosvenor Square, London, W.1.

Bankruptcies

Haine & Co., 77, Westbourne Grove, London, W.2, electricians.—Public examination 19th December at Bankruptcy Buildings, Carey Street, London, W.C.2.

C. F. Burns, High Street, Stalham, Norfolk, electrical and radio engineer.—Public examination 13th December at the Town Hall, Great Yarmouth.

Electrical Safety Courses

AN innovation in respect of electrical safety was inaugurated this year at the Burton Manor College (residential) for adult education. A safety course for engineers was conducted at which a number of electrical engineers from large industrial organizations, such as the British Electricity Authority, I.C.I., Unilever, etc., were present. There were lectures on factory law, protection, dangerous machinery, the effects of electricity on human beings, electrical installations in chemical works, static electricity, design and application of electronic apparatus, specifications for electrical installations, and the design and testing of flameproof apparatus and a feature was made of discussions. The standard of the papers was high and much of the information given in them was quite new.

The success of the course has encouraged the College to organize another next year, in two parts : the first from 27th April to 1st May is for chartered electrical engineers and university graduates ; the second from 23rd to 26th June will be more practical and is intended for foremen and similar staff.

Among the lecturers will be a number of H.M. Electrical Inspectors of Factories, Prof. Meek, of Liverpool University, and Prof. Williams, of the University College of North Wales, Bangor. One day will be devoted to the effects of electricity on human beings and the treatment of persons suffering from electrical injuries. The principal lecture on this subject will be given by Prof. S. Jellinek, professor of electro-pathology of Vienna University and director of the internationally known Electrical Accident Museum in Vienna. A number of foreign authorities on the effects of electricity on human beings have already indicated their intention of being present on that day, which will be of the nature of a discussion group.

Residential accommodation at the college for these courses is limited and early application for information should be sent to Dr. A. M. Brown, M.A., Ph.D., Burton Manor Residential College for Adult Education, Burton-in-Wirral, Cheshire.

STOCKS and SHARES

STOCK Exchange markets are once more under the influence of a number of depressing currents. Predominantly, the expectation of dearer money and the forthcoming announcement with reference to excess profits tax in early January, are factors which lay a heavy hand of restraint upon the investment of money and upon speculative enterprise. Foreign politics provide disturbing elements. At home, industrial companies continue to report what, on the whole, are excellent figures and, in spite of the fact that most boards of directors are adopting an extremely conservative policy in the distribution of profits, the long-term view is favourable to shares in the best-class companies. The acute flatness which developed in the early part of this week, in British Government securities, caused heaviness, however, in many other markets round the House.

General Setback

Most of the price changes which occurred since a week ago are downward. Automatic Telephones, 68s 3d, have lost 4s 9d, Enfield Cables are lower at 33s 9d. Amongst other falls, B.I. Callender's, 33s 6d, Ever Ready, 30s, Henley's, 22s, Associated Electrical, 86s 3d, E.M.I., 20s 6d, and Ericsson, 45s, give an idea of the trend in these markets. Lancashire Dynamo, 48s 9d, Pye, 22s, and Oriental Telephones, 48s 9d, have gone back. Electric Constructions, 33s 9d, Hoover, 31s, Telegraph Construction, 42s 6d, Westinghouse Brake, 58s 9d, C. A. Parsons, 55s, and General Electric, 92s 6d, are included with others that have declined. Gilt-edged stocks are noticeably weak.

Tube Investments

With no help from the general tendency of prices in the industrial market, Tube Investments £1 ordinary shares have failed to recover from the initial disappointment over the final dividend of 12½ per cent (making 25 per cent for the year, as before) and the price has come down by stages from £6½ to 5¾ ex dividend, the latter being worth a little over 1s 3d net. The quotation has been well over £7 during the course of this year. As in the similar case of Joseph Lucas, the market had felt justified in entertaining some optimism about this year's distribution. It was accompanied by a cautious statement by the directors on the subject of raw material supplies. Shortages in that respect have been increasing in severity, it is said, during a year which saw turnover, exports, profits and production all at record levels. Since the end of the financial year, the company has had to continue to use up steel stocks.

Lucas Dividend

Joseph Lucas are maintaining the utmost caution in dealing with a further increase, this time of a quarter of a million, in net profits for the year ended last July. Having regard to the ten-fold cover for last year's dividend of 6⅔ per cent, and the reserve financial strength already accumulated, the market had pitched its dividend expectations above the 7½ per cent total which has now materialized. Upon the announcement, the price of the shares fell from 41s 9d to 38s; it is now 37s 6d ex dividend. On these terms, the yield on the shares works out at an austere 4 per cent, which reflects credit on an earnings and financial position altogether above the ordinary. With the latest profit retentions added to reserves, the balance sheet seems likely to show that the amount of the latter, distributed two years ago through the 200 per cent capital bonus, has already been to a large extent replaced.

Extent of the Damage

Now that the dust of the election changes is beginning to settle, it is possible to get a clearer view of the effect which they have had on security prices. The following table presents a comparison of some present quotations with those ruling on polling-day and with the highest recorded this year:—

Stock or Share	1951 High	25 Oct.	Now
3% Brit. Elec., 1968–73 ..	97¼	90⅜	88⅝
3½% Brit. Elec., 1976–79 ..	103¾	95½	93½
A.E.I.	£5	94s 6d	86s 3d
English Elec.	74s 2d	71s 3d	65s
G.E.C.	99s 6d	97s 6d	92s 6d
Crompton Parkinson ..	13s	12s 6d	11s 6d
E.M.I.	24s 3d	24s 3d	20s 6d
Ekco	24s 6d	21s	19s 6d
B.I.C.	37s 9d	37s	33s 6d
Reyrolle	48s 3d	46s 3d	44s 6d
Telegraph Const.	47s	45s	42s 6d

Market Notes

Dealings in the million new shares issued with notable success this month by the East African Power & Lighting Co. are taking place at a premium of about 2s 6d on the offered price of 32s 6d. New 2s shares issued last month at par to shareholders in Peto Scott Electrical Instruments, Ltd., are quoted just above that figure: the company anticipates payment of a 10 per cent dividend on the larger capital. Ordinary shares of Ward & Goldstone, who have lately maintained the interim dividend at 10 per cent, are quoted in Manchester at about 45s. This payment applies to capital increased by 10 per cent, since last year, as a result of a free bonus issue. The last total was a well-covered 45 per cent.

CANADIAN ELECTRICAL IMPORTS

IMPORTS of electrical goods into Canada during the first half of this year showed some striking advances on the corresponding period of 1950. Some of the principal items are shown in the accompanying table with notes of increases or decreases (which were few) in kind not made in Canada increased notably while those from the United States fell off.

The United Kingdom and the United States were not the only countries competing in the trade. Germany sent small quantities of motors, transformers, precision instruments and

Class of Goods	Jan June, 1951 $ (000)	Inc. or dec. on first half 1950
Batteries, storage	404	+ 21
From United Kingdom	40	+ 20
„ *United States*	364	+ 1
Dynamos and parts	3,016	+ 1,135
From United Kingdom	169	— 64
„ *United States*	2 820	+ 1,187
Electric meters	856	+ 372
From United Kingdom	76	+ 46
„ *United States*	770	+ 318
Motors valued at less than $10	396	+ 26
From United Kingdom	77	+ 49
„ *United States*	319	— 23
Motors, other, and complete parts	7,951	+ 3,038
From United Kingdom	626	+ 134
„ *United States*	7,251	+ 2,851
Rheostats, controllers, etc.	4,218	+ 1,143
From United Kingdom	77	— 22
„ *United States*	4,097	+ 1,141
Transformers and parts	1,318	+ 244
From United Kingdom	376	+ 189
„ *United States*	922	+ 59
Switchgear for use in coal mines	145	+ 98
From United Kingdom	55	+ 21
„ *United States*	90	+ 77
Switches, switchboards, etc.	3,938	+ 1,236
From United Kingdom	195	+ 94
„ *United States*	3,620	+ 1,144
Telegraph apparatus	840	+ 154
From United Kingdom	34	+ 27
„ *United States*	805	+ 126
Sets and other radio apparatus (excluding valves) n.o.p.	11,330	+ 4,350
From United Kingdom	780	+ 430
„ *United States*	10,490	+ 4,700
Telephone apparatus	3,812	+ 218
From United Kingdom	808	— 47
„ *United States*	3,004	+ 265
Electric steam generators and parts of a kind not made in Canada	2,118	+ 913
From United Kingdom	2,094	+ 1,632
„ *United States*	24	— 713
Electric precision instruments	1,326	+ 240
From United Kingdom	72	— 27
„ *United States*	1,253	+ 268
Torchlights, flashlights, side and tail lights	652	+ 220
From United Kingdom	38	+ 2
„ *United States*	360	+ 118
Lighting fixtures and appliances	2,738	+ 1,033
From United Kingdom	37	+ 15
„ *United States*	2,577	+ 1,005

value. The share of the United Kingdom in the trade as a whole was fairly well maintained, but not in all lines. Switchgear for use in coal-mines was imported from the United States in greater value than from Great Britain. On the other hand imports of generators of a lighting fixtures; Switzerland some meters, dynamos, transformers and switchgear; Holland, radio goods; Belgium and Sweden some motors; Japan 1,100,000 m.f. lamps valued at $9,108,000; and Hong Kong large quantities of torchlights.

TRADE MARK APPLICATIONS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to 7th December next.

TELA (design). No. 691,237. Class 7. Sparking plugs, starting devices for engines (other than engines for land vehicles), conveyors (machines), conveying plant, mining machinery, electricity generators, electric motors (not for land vehicles), dynamos, lighting magnetos, electric welding machines and soldering apparatus included in Class 7 for the autogenous working of metals. TELA (design). No. 691,239. Class 9. Wireless transmitting and receiving apparatus and instruments, electro-acoustic apparatus and instruments (not for medical or surgical purposes), electronic sound amplifiers, sound reproducing apparatus for use in cinemas, electronic valve amplifiers and rectifiers, gas-filled electronic discharge tubes, photo-electric cells, electrical measuring apparatus and instruments, telecommunication apparatus, electric a.c. rectifiers, electric welding apparatus and electrodes, electric soldering irons, and parts of and fittings for all these goods, all included in Class 9; and parts of and fittings for electro-technical apparatus, all included in class 9.—Tesla Narodni Pdonik, Prague, Czechoslovakia. Address for service, c/o Reddie & Grose, 6, Bream's Buildings, London, E.C.4.

AEG (design). No. 693,119. Class 7. Electricity generators, electric motors, steam engines, steam turbines, gas turbines, and compressors included in Class 7, stone boring machines, electric welding machines, machine tools, electrically operated brakes for machinery, and electric washing machines; coffee grinding machines and food mixing machines.—Alkemeine Elektricität-Gesellschaft, Berlin-Grunewald, Germany. Address for service, c/o S. E. Matthews, 14–18, Holborn, London, E.C.1.

UNIVOX. No. 700,199. Class 9. Electrical sound amplifiers for use with musical instruments. VOX. No. 700,201. Class 9. Electronic apparatus for use in vibrating the sound emanating from musical instruments.—Jennings Musical Instruments, Ltd., 119, Dartford Road, Dartford, Kent.

HYDROTRON. No. 698,697. Class 11. Plant for treating liquid fluids electrically to counteract the effect of scale formation in heat exchange plant.—Aquastat, Ltd., Romney House, Tufton Street, Westminster, S.W.1.

NEXT WEEK'S EVENTS

Monday, 26th November

BIRMINGHAM.—James Watt Memorial Institute, Great Charles Street, 6 p.m. I.E.E. South Midland Radio Group. Informal lecture on "The Life and Reliability of Radio Valves," by Dr. G. H. Metson.

BOURNEMOUTH.—Grand Hotel, Firvale Road, 8.15 p.m. A.S.E.E. Bournemouth Branch. "Some Applications of Electricity in Gas Production," by O. H. Baker.

CARDIFF.—At the South Wales Institute of Engineers, Park Place, 6 p.m. I.E.E. Western Utilization Group. "The Development of the Electrical System on the Bristol Brabazon Mark I Aircraft," by M. J. J. Cronin.

LEEDS.—Lighting Service Bureau, 24, Aire Street, 7 p.m. I.E.S. Leeds Centre. "Hospital Lighting," by J. K. Frisby.

LONDON.—Savoy Place, W.C.2, 5.30 p.m. I.E.E. Radio Section. Discussion on "Should Broadcasting be Superseded by Wire Distribution?" opened by P. P. Eckersley

NEWCASTLE-ON-TYNE.—Neville Hall, Westgate Road, 6.15 p.m. I.E.E. North-Eastern Centre. "The Dimming of Low-Pressure Discharge Lamps," by C. E. Williams.

Tuesday, 27th November

LEEDS.—Lighting Service Bureau, Aire Street, 6.30 p.m. I.E.E. North Midland Utilization Group. "A New Power Stroboscope for High Speed Flash Photography." by W. D. Chesterman, D. R. Clegg, G. J. Peck and A. J. Meadowcroft.

LONDON.—Savoy Place, W.C.2, 7 p.m. I.E.E. London Students' Section. "The Use of Working Scale Models in the Development of Broadcasting Aerials," by T. R. Boys.

At the Royal Society of Tropical Medicine & Hygiene, Manson House, Portland Place, W.1, 7 p.m. Society of Instrument Technology. "The Visual Presentation of Instrument Data," by K. F. H. Murrell.

MANCHESTER.—Engineers' Club, Albert Square. I.E.E. North-Western Utilization Group. Conference on the I.E.E. Report on "Electricity as an Aid to Productivity," with three lectures. 10 a.m., "Motive Power in the Factory," by H. Dreghorn. 2.30 p.m., "Handling of Materials," by G. V. Sadler. 6.15 p.m., "The Inspection of Materials," by J. Foster Veevers.

WORCESTER.—Works Institute, Hylton Road Power Station, 7.15 p.m. I.E.E. South Midland Centre. District meeting. "The Design and Performance of Surge Divertors for the Protection of Alternating-Current Systems," by T. F. Monahan.

Wednesday, 28th November

BELFAST.—Belfast Association of Engineers. "Automobile Instruments," by J. A. Shingleton. (Joint meeting with the Institution of Production Engineers.)

EXETER.—Rougemont Hotel, 3 p.m. I.E.E. South-Western Sub-Centre. Informal lecture on "The Operation and Maintenance of Television Outside-Broadcast Equipment," by T. H. Bridgewater.

LONDON.—Savoy Place, W.C.2, 5.30 p.m. I.E.E. Supply Section. "A Statistical Approach to some Problems in Electricity Supply," by R. B. Rowson.

Lighting Service Bureau, 2, Savoy Hill, W.C.2, 6 p.m. Illuminating Engineering Society. Informal meeting. Report and discussion on the 1951 meeting of the C.I.E.

MANCHESTER.—Engineers' Club, Albert Square, 6.30 p.m. I.E.E. North-Western Radio Group. "An Investigation into the Mechanism of Magnetic Recording," by P. E. Axon.

NEWCASTLE-ON-TYNE.—Old Assembly Rooms. E.I.B.A. North-Eastern Area ball.

Thursday, 29th November

GLASGOW.—At the Institution of Engineers and Shipbuilders, 39, Elmbank Crescent, 7 p.m. I.E.E. Scottish Centre. "The Use of Saturable Reactors as Discharge Devices for Pulse Generators," by W. S. Melville.

LUTON.—George Hotel, 8 p.m. A.S.E.E. Luton Branch. "Oil Switchgear Failures and Their Causes," by N. Elliott.

Friday, 30th November

LONDON.—St. Pancras Town Hall, Euston Road, N.W.1, 7 p.m. I.E.E. London Students' Section. Joint dance with the Institutions of Civil and Mechanical Engineers.

Saturday, 1st December

LONDON.—I.E.E. London Students' Section, 9 a.m. Visit to Odeon Theatre, Leicester Square.

Copper Booklet

IN response to requests both from teachers and students a booklet entitled "Copper: its Ores, Mining and Extraction" has been issued free of charge by the Copper Development Association, Kendals Hall, Radlett, Herts.

It describes in simple language how commercial copper is obtained by mining, ore dressing, smelting, refining and fabrication, the various steps in processing being illustrated by means of numerous photographs and diagrams in the 47 pages of text, while the distribution of copper ores in the principal producing countries of the world is indicated on a map.

Copper is mined in seven countries within the British Commonwealth, the total production in 1950 being estimated at 696,000 tons. The Commonwealth's total annual consumption of virgin copper exceeds ½ million tons, about three-quarters of which is taken by Britain alone. These figures do not include such secondary copper as that derived from scrap metal, very large tonnages of which are melted and refabricated every year.

I.E.E. Centre Dinner

Speeches at Liverpool Gathering

THE shortage of engineers was one of the themes of the speech by Mr. J. Eccles, vice-president, Institution of Electrical Engineers, and chairman of the Merseyside and North Wales Electricity Board, at the annual dinner of the I.E.E. Mersey and North Wales Centre of the Institution of Electrical Engineers at Liverpool on 12th November.

He said that although the I.E.E. was the largest engineering institution in the world, its strength ought not to be measured by mere numbers but by wise direction from headquarters and the energy and virility of the individual members in the Centres. An essential ingredient of wise direction was the maximum degree of decentralization. The work of the Centres went on without interference from headquarters, or from each other, and it was an interesting thought that on every weeknight from the middle of October to the end of March, there was always an I.E.E. meeting in progress somewhere in this island.

Engineers were the key people in the great enterprise of maintaining an acceptable standard of living for our population. By the efficient design and careful maintenance of all machinery used in this country, they helped to achieve the greatest outputs and ensured that the highest proportion of material was left over to fulfil export requirements.

The power engineer could make a major contribution in keeping the wheels of industry turning at full speed all the time. The battle for survival was being fought in squares, and whichever way one turned engineers seemed to be in the front rank. The trouble was that there were not enough engineers. In the United States, for example, there were at least five times as many engineers per thousand employed persons as in this country. We could not hope to produce a five-fold increase in engineering personnel in any reasonable time, but we did want a substantial increase; especially did we need to offset the deficiency in numbers by the quality of those we had.

Sir Rex J. Hodges, general manager of the Mersey Docks and Harbour Board, who proposed the toast of the I.E.E., said the port of Liverpool had grown up with the electricity industry and the Institution. After referring to developments in radar and the portable wireless telephone, he said he would like to see members of the Institution apply themselves to the use of television to enable the Board to get more information by sight measures than they could now get by radar. The present difficulty with television was that, at the initial instrument end, it would not work through fog. What was wanted was an instrument that would see through fog as radar did, but which would also give greater detail. There was also need for an instrument that would enable a more satisfactory examination to be made of things under water, bearing in mind that there was much mud in the River Mersey. Such an instrument would be of enormous value in examining sunken ships, on salvage work, and in examining with accuracy damage to, or the condition of, dock gates and sills under water. These were recommended as targets worthy of the skill of electrical engineers. Since 1901 the Mersey Docks and Harbour Board had made great strides in the utilization of electricity for lighting and power on the dock estate, but it still had a long way to go. So far as lighting was concerned, one of the troubles was that every improvement automatically put out of date about three-quarters of the existing installations and then everybody started complaining. Hydraulic power was being replaced by electric power. Consumption of electricity on the dock estate at the beginning of the century was 750,000 kWh a year; to-day it was 47,000,000 kWh.

Other speeches were made by Mr. E. W. Ashby (chairman), the Lord Mayor of Liverpool (Ald. Vere E. Cotton, C.B.E., T.D.) and Mr. D. C. Fleming.

Tees-Side Reunion

AT the annual dinner and reunion of the Tees-Side Sub-Centre of the Institution of Electrical Engineers, Mr. R. E. Newell, chief engineer at the Wilton (North Yorkshire) Works of the I.C.I., said he would like to see one Institution of Engineers rather than separate bodies for the different branches. Mr. Newell, who was proposing "The I.E.E.," expressed the view that there was too much specialization in the engineering industry. Mr. J. Eccles, vice-president of the Institution, said that the future of the country depended upon the successful training of engineers, and the I.E.E. was helping the Ministry of Education to plan this higher technical training. Referring to higher production, Mr. Eccles said it was the job of the power engineer to keep industry going at full speed to allow maximum production; the works engineer could, be designs, save materials and keep the wheels of industry going; and the agricultural engineer could help take the backache out of farming and keep more men on the land to grow food.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (2s each) will be obtainable after 2nd January from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1946

19970. Compagnie Générale d'Electricité.—Telephone systems. 8th October, 1946. (664241.)

1947

15785. Philips Lamps, Ltd.—Electronic discharge-tube amplifiers. 16th June, 1947. (664341.)

22126. Sperry Gyroscope Co., Inc.—Electron-discharge devices adapted for frequency changing. 8th August, 1947. (664041.)

26663. Igranic Electric Co., Ltd., and Field, J. A.—Electric protective or indicating circuits for polyphase alternating current circuits. 4th October, 1948. (664344.)

1948

2539. Souget, M. L. M.—Amplification of telephone reception. 28th January, 1948. (664141.)

4288. British Thomson-Houston Co., Ltd.—Methods of and apparatus for manufacturing electric discharge devices. 13th February, 1948. (664347.)

5954. Director of the Office of Technical Services, Department of Commerce.—Thermionic valve circuits. 27th February, 1948. (664244.)

7903. Metropolitan-Vickers Electrical Co., Ltd., Simmons, J. D., Liversidge, J. H., and Wrathall, R. W.—Electrical measuring and control systems. 11th March, 1949. (664065.)

9120. Radley, W. E. (Aeroquip Corporation).—Pressure-responsive devices for actuating electrical indicating means. 31st March, 1948. Convention date not granted. (664354.)

9293. Wayne Kerr Laboratories, Ltd., and Calvert, R.—High-frequency transformers. 16th March, 1949. (664355.)

14288. Birlec, Ltd.—Measurement and control of temperatures in metal melting furnaces. 27th May, 1948. (663942.)

16576. Birlec, Ltd.—Multi-chamber induction furnaces. 21st June, 1948. (663943.)

17143. Sperry Products, Inc.—Pulse transmitting and receiving apparatus. 25th June, 1948. (664360.)

17614. Igranic Electric Co., Ltd.—Apparatus for obtaining an electrical output in accordance with a function of one or more variables. 30th June, 1948. (664361.)

19129. Westinghouse Electric International Co.—Fuel control systems for gas turbine power plants. 16th July, 1948. (664245.)

20493. Felgate Radio, Ltd., and Williams, A. S.—Wireless receivers and like apparatus. 5th August, 1949. (664246.)

21602. Radio Corporation of America.—Dielectric ceramic composition and method of producing it. 16th August, 1948. (664370.)

22775. Gretener, E.—Optical device for obtaining even illumination in space. 30th August, 1948. (664250.)

29093. Western Electric Co., Inc.—Electron-discharge devices. 9th November, 1948. (664253.)

30320. British Thomson-Houston Co., Ltd.—Dynamo-electric machines. 22nd November, 1948. (664254.)

32346. Dehn, S. G. (Globe-Union, Inc.).—Electrical switch and variable resistor for miniature electrical apparatus. 14th December, 1948. (664257.)

1949

677. British Broadcasting Corporation, Brownless, S. F., and Monteath, G. D.—Slot aerials. 9th January, 1950. (664150.)

1046. Turner, G., and Morris, J. T.—Electric battery lamps and electric torches. 16th January, 1950. (664154.)

1639. General Electric Co., Ltd., and Luck, G. A.—Electric measuring, testing, or indicating means. 20th January, 1950. (664160.)

2294. Woods of Colchester, Ltd., and Daly, B. B.—Wings for axial-flow fans. 27th January, 1950. (664171.)

2437. Hasler Akt.-Ges. Werke für Telephonie und Prazisionsmechanik.—Electric filter. 28th January, 1949. (664174.)

2487. Siemens Electric Lamps & Supplies, Ltd., and Freestone, R.—Starting circuits for fluorescent electric lamps. 27th January, 1950. (664043.)

2822. Automatic Telephone & Electric Co., Ltd.—Automatic switches for use in telephone or like systems. 5th January, 1950. (664261.)

3354. Metropolitan-Vickers Electrical Co., Ltd.—Control systems of the correspondence kind for movable members. 27th February, 1950. (664263.)

3447. General Electric Co., Ltd., and Clack, B. N.—Manufacture of sealed hollow bodies comprising at least one transparent vitreous window. 23rd January, 1950. (664181.)

4150. General Electric Co., Ltd., and Judd, S. R.—Means for the rheostatic braking of direct current electric motors. 26th January, 1950. (664188.)

4951. Philco Corporation.—Frequency dividing circuits 23rd February, 1949. (664050.)

4981. General Electric Co., Ltd., and Stenning, L. C.—Radio navigational systems. 9th February, 1950. (664268.)

5891. British Broadcasting Corporation, and Roberts, W. A.—Apparatus for checking the frequency of high-frequency electric oscillations. 2nd March, 1950. (664195.)

6289. United Insulator Co., Ltd., and Hiles, E. J.—Electric capacitors. 7th March, 1950. (664198.)

8266. Electric & Musical Industries, Ltd.—Television camera cable circuit arrangements. 14th March, 1950. (664068.)

8511. General Electric Co., Ltd., and Hewitt, W. H. L.—Arrangements for resiliently mounting apparatus in a container. 29th March, 1950. (664070.)

8598. Cambridge Instrument Co., Ltd., and Parnum, D. H.—Electrical null-point indicating devices. 23rd March, 1950. (664279.)

8998. Revo Electric Co., Ltd., and Felton, A. E.—Louvres for electric lighting fittings. 3rd April, 1950. (664072.)

9050. Osborn Manufacturing Co., Ltd., and Greenwood, P. S. V.—Electric lighting fitting. 4th April, 1950. (664282.)

9301. Cooper, H. C.—Electric isolating switches for use in electric circuits embodying fuses. 5th July, 1950. (664073.)

9404. General Electric Co., Ltd., and McGarry, D. W.—Electric lighting installations. 12th May, 1950. (664284.)

9527. General Electric Co., Ltd., and Farnsworth, J.—Manufacture of inductance coils. 4th April, 1950. (664074.)

9703. Kinsey, J. F.—Electric water heating apparatus particularly for greenhouses or the like. 5th April, 1950. (664076.)

9740. Rotax, Ltd.—Electrically heated aircraft de-icing means. 10th March, 1950. (664286.)

10126. Plessey Co., Ltd.—Radio frequency oscillators. 2nd February, 1950. (664078.)

10336. Standard Telephones & Cables, Ltd.—Electron-discharge devices. 14th April, 1950. (664289.)

10850. Rubert, M. P.—Combined ventilation and work illuminating device. 25th April, 1950. (664083.)

12163. Rheostatic Co., Ltd.—Small spring return valve or damper operating motors. 1st May, 1950. (664090.)

13274. British Thomson-Houston Co., Ltd.—Lighting fixtures. 18th May, 1949. (663957.)

15015. Noir, R.—Corrosion-inhibiting connecting device adapted to secure an electric cable on a storage battery terminal or like member. 3rd June, 1949. Cognate application 15016, 12th November, 1948. (663962.)

15927. Wotscke, J.—Electrode for electric melting furnaces. 15th June, 1949. (664298.)

16183. Westinghouse Electric International Co.—High-frequency electrical apparatus. 17th June, 1949. (663968.)

16473. General Electric Co., Ltd., and Barry, J. N.—High-voltage direct current power supplies. 21st June 1950. (663969.)

16724. Siemens Bros. & Co., Ltd.—Electrical protecting devices. 23rd June, 1950. (663972.)

16725. Siemens Bros. & Co., Ltd., and Long, D. P.—Step-wise control of a motor-driven uniselector of the kind used in telephone and like selective systems. 23rd June, 1950. (663973.)

17339. Telefonaktiebolaget L. M. Ericsson.—Modulator of electric oscillations employing the phenomena of superconductivity. 30th June, 1949. (663976.)

17355. Radio Corporation of America.—High-frequency heating system. 30th June, 1949. (664107.)

17551. Hirschler, I.—Dialling device for automatic telephone instruments. 2nd July, 1949. (663977.)

18128. General Motors Corporation.—Method of and apparatus for electrostatically coating articles. 8th July, 1949. (664110.)

18645. Gonzalo, J., and Urgoiti, J. N. de. Electrically heated vessels. 14th July, 1949. Cognate application 18646, 19th February, 1949. (664113.)

18857. British Thomson-Houston Co., Ltd.—Ultra-high-frequency electric heating apparatus. 18th July, 1949. (664207.)

18975. Westinghouse Electric International Co.—Electric valve converting apparatus especially for resistance welding. 19th July, 1949. (664302.)

19169. Sylvania Electric Products, Inc.—Method of preparing electron-emissive coating materials. 20th July, 1949. (663981.)

19309. Newby, R. L. (Allmanna Svenska Elektriska Aktiebolaget).—Lighting regulation systems for theatre lighting and the like. 22nd July, 1949. Convention date not granted. (663984.)

19340. Standard Telephones & Cables, Ltd., Grayson, H., and Dunkley, R. A. G.—Electric frequency modulation systems of communication. 22nd July, 1949. (663803.)

19370. English Electric Co., Ltd.—Surface condensers. 14th July, 1950. (663985.)

20070. Kelvin & Hughes, Ltd.—Electric control systems. 19th June, 1950. (664118.)

20072. National Research Development Corporation.—Electric integrating or control apparatus. 31st July, 1950. (664306.)

20108. Philips Electrical, Ltd.—Circuit arrangements for generating direct voltages. 2nd August, 1949. (663987.)

20414 & 20416. Westinghouse Electric International Co.—Control systems for electric motors. 5th August, 1949. (664379 & 664210.)

21258. British Heat Resisting Glass Co., Ltd., and Hann, D. G.—Electrodes for electrically heated glass melting furnaces. 16th August, 1950. (664121.)

21270. Renfrew Electric & Refrigerator Co., Ltd.—Electric pilot lamp units. 16th August, 1949. (663992.)

21431. Oldham & Son, Ltd., and Martin, J. R.—Electric accumulators. 13th July, 1950. (663995.)

21588. Triggs, W. W. (Wyandotte Chemical Corporation).—Electrically conducting chemical solution strength control device. 19th August, 1949. (663677.)

21590. Akt-Ges. Brown, Boveri & Cie.—Electrically heated tunnel furnace. 19th August, 1949. (663996.)

22037. Radio Corporation of America.—Sawto[o]th wave generator. 24th August, 1949. (664216.)

22546. Expanded Metal Co., Ltd.—Electrical resistance and heater elements. 30th August, 1949. (663999.)

22601. Mueller, M.—Electrical contact sockets with longitudinal slits and a method as well as a device for the production of said sockets. 31st August, 1949. (663602.)

22701. Philco Corporation.—Apparatus adapted for connecting the contact pins of an electrical device with associated electrical circuits. 1st September, 1949. (663904.)

22921. Chloride Electrical Storage Co., Ltd.—Electric accumulators. 9th August, 1950. (664003.)

23185. Holophane, Ltd. (Holophane Co., Inc.).—Lighting installations. 7th September, 1949. (664004.)

23483. Ortenblad, S. J. V.—Time-controlled electric switching apparatus. 12th September, 1949. (664006.)

23742. Trist & Co., Ltd., R., and Chambers, W. A.—Electric relays. 14th September, 1950. (664314.)

23797. Smee, G. C. W.—Electrical apparatus for signalling or advertising. 15th September, 1950. (664008.)

24043. British Thomson-Houston Co., Ltd.—Methods of and apparatus for moulding articles of cellular plastic material. 19th September, 1949. (664318.)

24495. British Thomson-Houston Co., Ltd., and Chafer, H. J.—Electric selecting and starting switch for turbo starters. 10th August, 1950. (664321.)

24678. Radio Corporation of America.—Stabilization of frequency-modulated oscillators. 26th September, 1949. (664011.)

24821. Siemens & Halske Akt.-Ges.—Relay interruptor circuits in communication installations in particular telephone installations. 27th September, 1949. (664015.)

25185. British Thomson-Houston Co., Ltd., and Vivian, G. E.—Noise-reduction in transformers and reactors. 22nd September, 1950. (663680.)

25520. Metropolitan-Vickers Electrical Co., Ltd.—Brazing mixtures. 23rd May, 1950. (664018.)

25791. Soc. Anon. A. Citroen.—Electric accumulator connections. 7th October, 1949. (663681.)

26084. British Thomson-Houston Co., Ltd.—Voltage regulating systems employing saturable core reactors. 11th October, 1949. (664021.)

26186. Philips Electrical, Ltd.—Sub-assembly units for electrical components. 12th October, 1949. (664024.)

26450. Standard Telephones & Cables, Ltd.—Method and device for cutting and high frequency welding parts of thermo-plastic material in one operation. 14th October, 1949. (664128.)

27693. Philips' Electrical, Ltd.—Rear-lighting fittings for vehicles. 28th October, 1949. (663683.)

27946. Compagnie des Freins & Signaux Westinghouse.—Method and apparatus for purifying selenium and similar semi-conductive substances. 1st November, 1949. (664030.)

27973. British Thomson-Houston Co., Ltd.—Laminated magnetic core constructions for electric induction apparatus. 1st November 1949. (664332.)

28735. British Thomson-Houston Co., Ltd.—Indicating devices. 9th November. 1949. (664333.)

28916. Ashley Accessories, Ltd., and Everett, L. H. R.—Dolly-operated electric switches. 11th November, 1949. (664131.)

29221. British Thomson-Houston Co., Ltd.—Automatic tuning systems. 15th November, 1949. (664227.)

29615. London Express Newspaper, Ltd., and Ashton, C. J.—Electrical moisture meters for flong or other moisture absorbent materials. 11th May, 1950. (664037.)

31649. Anderson, J. M.—Thermally controlled electric frying stoves. 9th December, 1949. (664337.)

32064. Philips Electrical, Ltd.—Electrical plug pins. 14th December, 1949. (664380.)

32497. British Thomson-Houston Co., Ltd.—Magnetic cores. 19th December, 1949. (664382.)

32568. Compagnie Générale d'Electricité—Device for measuring the Q-factor of resonant systems. 20th December, 1949. (664383.)

32634. Canfield, E. L.—Desk lighting unit and work surface. 20th December, 1949. (664384.)

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section, the date of the issue is given in parentheses.

Australia.—BRISBANE.—23rd January. State Electricity Commission of Queensland. Supply of two 2,000 kVA 6,600/66,000 V transformers. (C.R.E. (I.B.) 7533/51. Ten/3232.)* 30th January. Supply of steel cored aluminium conductors and accessories. (C.R.E. (I.B.) 75293/51. Ten/3236.)*

Belfast.—4th January. City Electricity Department. Overhead travelling crane, electric lift, workshop machinery and equipment, weighbridge and lighting, heating and auxiliary power installation at Harbour power station. (See this issue.)

Edinburgh.—North of Scotland Hydro-Electric Board. Supply of 22 kV, 11 kV and lower voltage distribution lines. (See this issue.)

Gateshead. — 7th January. Corporation. Electrical installation at new Technical College (stage II). (See this issue.)

Kidwelly.—10th December. Town Council. Two submersible and four horizontal centrifugal pumping units. A. P. I. Cotterell & Son, engineers, 54, Victoria Street, Westminster, S.W.1.

London. — WANDSWORTH. — 19th December. Borough Council. Street lighting equipment. (See this issue.)

Longbenton. — 30th November. U.D.C. Electrical installations in 30 houses at Holystone estate, Shiremoor. (See this issue.)

Newcastle-on-Tyne. — 17th December. Education Committee. Installation of electric lighting and power at the Stocksfield Avenue Primary School. H. V. Lightfoot, director of education, Northumberland Road.

Norton (Yorks).—6th December. R.D.C. Electrical installations in 22 houses at Northstead, Duggleby, near Malton. R. W. Clayton, architect, Council Offices, Norton, Malton.

Pitlochry.—10th December. Town Council. Street lighting equipment. (See this issue.)

Portugal.—LISBON.—19th December. Directorate General of Hydraulic Services. Electromechanical equipment for pumping stations. (C.R.E. (I.B.) 75641/51. Ten/3250.)*

Uruguay. — MONTEVIDEO. — 28th December. Administracion Nacional de Combustible Alcohol y Portland. Supply of 850 metres of armoured cable and accessories. (C.R.E. (I.B.) 75486/51. Ten/3254.)*

*Specifications may be inspected at the Commercial Relations and Exports Department, Board of Trade, Thames House North, Millbank, S.W.1 (Victoria 9040).

ORDERS PLACED

Alnwick (Northumberland). — U.D.C. Provision of 139 electric street lamps in connection with the plan for converting gas street lighting to electricity (£3,560).—B. L. Oliver (Birtley).

Birmingham. — Corporation. Electrical installations: Shard End Junior School and canteen.—Baxter & Impey, Ltd. First sections of Colleges for Technical, Commercial and Art Education at Gosta Green.—Midlands Electricity Board. Canteen, St. Peter's C.E. School, Harborne.—W. J. Sheath. Lickey Road School, Rednal.—Thomas Glover (Electrical), Ltd.

Durham.—County Council. Electrical work: Heath House Hostel (£210).—R. Robson. Shire Hall staff canteen (£239).—T. Henderson. Medomsley Children's Homes (£725).—G. A. Walton. Stockton Children's Homes (£112).—Stewart & Son. Hebburn Fire Station (£351).—A. Robertson, Ltd.

Manchester.—Corporation Education Committee. Recommended. Electrical installation at Manchester Training College.—F. Wall & Co., Ltd. Electrical installation work at Button Lane and Poundswick Primary Schools.—R. A. Ranson.

Health Committee. Re-wiring two homes at Langho Colony.—R. A. Ranson.

Watch Committee. Electrical installation at Moss Side Fire Station.—A. E. Sudlow & Co., Ltd.

Middlesex.—County Council Education Committee. Alterations to the electric lighting installations in certain workshops at Enfield Technical College (£1,526).—Watson & May, Ltd.

CONTRACTS IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Accrington.—Flats (108), Burnley Road estate; borough surveyor.

Aylesbury.—Old people's home, Walton Road; county architect, Walton Street.

Pathological laboratory at Stoke Mandeville Hospital; Oxford Regional Hospital Board, 43, Banbury Road, Oxford.

Barking.—Extensions (£135,000) at South East Essex Technical College and School of Art; H. Conolly, architect, County Hall, Chelmsford.

Barnard Castle.—Houses (38) for the R.D.C. at Stainton, Cockfield, Woodland and Gainford; R. C. Williamson, Ltd., builders, Rowlands Gill.

Barrow-in-Furness.—Walney County Nursery School (1952 programme); borough engineer.

Belfast. — Extensions to Belfast Royal Academy, including hall, classrooms, dining hall, kitchen, offices, etc.; A. G. Crawford, quantity surveyor, 1, Lombard Street, Belfast.

Birkenhead.—Central maintenance and repair depot at Cleveland Road; borough architect, 1, Mortimer Street.

Birmingham.—Reconstruction of Summer Hill Home (£54,800); H. J. Manzoni, city engineer.

Bishop Auckland.—Fire station (£58,000); county architect, Court Lane, Durham.

Boscombe.—Research laboratory at Royal Victoria Hospital; Reynolds, Tomlins & Dexter, architects, Granville Chambers, Yelverton Road, Bournemouth.

Boston.—New offices; Lincolnshire Rivers Fishery Board, 10, New Street.

Carlisle.—Corporation Education Committee. Electrical work at Harraby Infants' School (£2,123).—Robert Batey & Co.

Chatham.—Flats (28), Jenkins Dale; E. W. Ballard, Ltd., builders, Longley Road, Rainham.

Cheshire. — Secondary schools at Upton, Weaverham, Bebington, Shavington and Alsager in 1952; county architect, Chester.

Clacton-on-Sea.—Extensions to St. Osyth's Teachers' Training College; A. R. Dannatt & Son, architects, 65a, Duke Street, Chelmsford.

Cumberland. — Laboratory and classroom block at White House School; county architect, Portland Square, Carlisle.

Dagenham.—Factories at Hainault industrial estate: Hilmor, Ltd., 65, Calshot Street, N.1, and Sonneborn & Rieck, Ltd., South Grove, St. Ann's Road, N.15.

Doncaster.—Adaptations at Rossington Hall (£45,341); Fred Pearson & Co., 32, Cemetery Road, Doncaster.

Dudley.—Works extensions; Thomas Dudley, Ltd., Wolverhampton New Road, Tipton.

Durham. — Administrative block for fire brigade headquarters at Framwellgate Moor (£28,160); Thomas Armstrong, Ltd., builders, Robson Street, Newcastle-on-Tyne.

East Ham.—Multi-storey modern school, Plashet Grove (eight floors); H. A. Edwards, town clerk, Town Hall, E.6.

Enfield.—Flats (44), maisonnettes and shops, Enfield Road; U.D.C. surveyor.

Edinburgh.—Extensions to Heriot-Watt College, third section, for governors; J. Y. White, Clerk to Governors, Heriot-Watt College.

Ellesmere Port.—New civic hall; Gornall, Kelly & Shelton, architects, 69, The Albany, Old Hall Street, Liverpool.

Exeter.—Showrooms and offices for British Home Stores, Ltd.; S. Pratt, Ltd., builders, Old Ryden Lane.

Felling-on-Tyne.—Houses (156); H. Fawcett, surveyor, U.D.C. Offices, Felling.

Flintshire.—Erection of Trenddyn, Astbury, Vownog Hill, Penyfford and Flintshire Rhosesmor Schools, and additions to Hope School; G. & R. Brimblecombe, Ltd., Chester Road, Buckley.

Halifax.—Flats (72), bungalows (26) and houses (14), Willowfield; borough surveyor, Crossley Street.

Haltwhistle.—Two storage buildings for Ministry of Food; John Jackson & Son, contractors, 72, Corporation Street, Newcastle-on-Tyne.

Harlow.—Factory for Dorstel Press, Ltd., 341 Bromley Road, S.E.6; Boyd Gibbins, builder, 285, Romford Road, E.7.

Harrogate. — Territorial Army training centre; Jackson & Calvert, architects, 3, Raglan Street.

Hemsworth.—Bungalows (40), Moorshutt Road site; Pennington, Hustler and Taylor, architects to U.D.C., White Hall, Hemsworth, near Pontefract.

Hornchurch.—Maisonnettes (64), for U.D.C.; surveyor.

Kettering.—Fire station headquarters in stages over the next few years; county architect, Northampton.

Liverpool.—Classrooms and gymnasium at Olive Mount Secondary Modern School (£76,664); Peak Construction Co., Ltd., 49, Hamilton Square, Birkenhead.

London.—HAMPSTEAD.—Flats (100), Finchley Road; Louis de Soissons & Partners, architects, 3, Park Square Mews, N.W.1.

MARYLEBONE.—Police station and offices, Nottingham Place; Vine & Vine, architects, Tudor Chambers, Station Road, N.22.

Manchester.—Erection of Crab Lane Primary School; G. & J. Seddon, Ltd., Little Hulton, nr. Bolton.

Monmouthshire.—Extensions to grammar schools at Abertillery and Pontllanfraith; county architect, Queen's Hill, Newport.

Northumberland.—New workshops at Walbottle (£80,000) and county primary school, Morpeth (£54,230); county surveyor, County Hall, Newcastle-on-Tyne.

Peterlee (Co. Durham). — Fire station (£55,000); G. R. Clayton, county architect, Court Lane, Durham.

Prescot.—Houses (56), Shaw Lane site; Gornall, Kelly & Shelton, architects to U.D.C., 8, Hardshaw Street, St. Helens.

Rochdale.—Extensions at Spotland Works for Turner Bros. Asbestos, Ltd.; H. S. Fairhurst & Son, architects, 55, Brown Street, Manchester.

Salford. — Police headquarters, Crescent; Bradshaw, Gass & Hope, architects, 19, Silverwell Street, Bolton.

Sheffield.—Factory, Carlisle Street; Davenport Bros., Ltd., 91, Spital Hill.

Wellingborough.—Health clinic (£12,289) for Northants C.C.; W. J. Richardson & Son, Northampton.

West Ham.—Maisonnettes (24), Rogers Road area, and 10 houses and 20 maisonnettes, Granville Road area; T. E. North, borough architect, 70, West Ham Lane, Stratford, E.15.

Wigan.—Erection of new church of St. Anne at Beech Hill; John Johnson & Sons, Caroline Street, Wigan.